Department of Materials Science and Engineering

University of Tennessee - Knoxville

Undergraduate Student Handbook

Fall 2005

434 Doughety Engineering Building

Undergraduate Student Handbook
Department of Materials Science and Engineering
University of Tennessee, Knoxville

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I. Welcome to the Department

Welcome to the Department of Materials Science and Engineering at the University of Tennessee, Knoxville. The departmental faculty believes that you have selected an exciting and rewarding program of study. Programs in the materials field (i. e., Materials Science and Engineering, Materials Engineering, Metallurgical Engineering, Polymer Engineering) are often classified as "enabling technologies". Almost every product that one uses from clothing to advanced aircraft depends upon the properties of materials for performance. The ability to control properties through processing or synthesis methods and through control of composition and microstructure allows us to tailor materials for a specific application with reasonable costs and high degrees of reliability and safety. In a paraphrase of a current television commercial, "we don't make things. We make them possible!"

In addition to the Bachelor of Science in Materials Science And Engineering, the department offers graduate studies leading to the degrees of Master of Science and Doctor of Philosophy with a major in either Materials Science and Engineering or Polymer Engineering. Opportunities to participate in the research activities associated with these programs are often offered to undergraduate students. Additionally, the University of Tennessee - Knoxville has identified "materials" as a campus-wide focus area.

The student body of the department runs a very active student joint Chapter of ASM International and The Minerals, Metals, and Materials Society of AIME, and a Society of Plastic Engineering Student Chapter. Their activities are often coordinated with the Oak Ridge Chapter of ASM International. Students are invited to attend all activities of that professional organization. Additionally, a fund has been created to assist the payment of entering students dues in order to encourage your participation. Please, contact the student president or the faculty advisor, for details.

Your faculty advisor and departmental head are your front line advocates. If you encounter any problems, you are encouraged to discuss the details with one or both of them.

George Pharr
Professor and Head

II. Mission Statements

University of Tennessee, Knoxville, Mission Statement

The University of Tennessee, Knoxville, is committed to the development of individuals and society as a whole through the cultivation and enrichment of the human mind and spirit. Our mission is accomplished through teaching, scholarship, artistic creation, public service, and professional practice.

An elaboration of this statement follows:

The first priority of UTK faculty, staff, and administrators is the education of our students, from freshmen to postdoctorals, through a creative balance of academic, professional, extracurricular, and athletic programs of the highest quality. The centrality of liberal learning is affirmed with particular emphasis on the integration of liberal and professional learning. We are committed to excellence in disseminating knowledge and skills to our students, while at the same time helping them to develop critical thinking skills, acquire wisdom and insight, promote self awareness and self understanding, affirm diversity as an opportunity for personal growth and development, understand ethical and moral issues, and be committed to the pursuit of truth in all endeavors.

Scholarship of the highest quality by our faculty and students is central to our mission. It is always to be pursued in balance with good teaching and with an understanding of the potential for quality teaching and scholarship to reinforce and enrich each other. UTK aspires for its scholarship to be of increasing national and international relevance and recognition. We affirm that good teaching requires more than just teaching the knowledge of others but requires contributing through active scholarship to what is to be taught, thought, and practiced in the education of students.

UTK aspires to be a university of choice by persons of different backgrounds. We are committed to an expanded international perspective and emphasis at all levels. Constant attention to a sense of community for all members of the diverse university community is a high priority.

UTK College of Engineering Mission Statement

To provide high quality education in the major engineering disciplines from the undergraduate through doctoral levels through a creative balance of academic, professional, and extracurricular program;

To foster and maintain mutually beneficial partnerships with our alumni, friends, industry, and local, state and federal governments through public service assistance and collaborative research; and

To be a major contributor to our nation's technology base through scholarship and research.

UTK Department of Materials Science and Engineering Mission Statement

Provide quality education, BS through PhD, in the field of materials;

Develop new materials and new knowledge about existing materials, methods of processing, and materials utilization;

Perform public service in the discipline and encourage professionalism in our students;

Foster mutually beneficial relationships with alumni, industry and government;

III. Purpose of the Undergraduate Student Handbook

This handbook provides supplementary information to that contained in the University of Tennessee **Undergraduate Catalog** and the student handbook **"Hilltopics"** that pertain specifically to the Department of Materials Science and Engineering and its undergraduate program. It provides detailed information about the faculty, undergraduate degree program, policies and procedures. This edition is based on the University of Tennessee **Undergraduate Catalog 2004-05.** It is hoped that this handbook will assist you in making the transition from student to an engineer.

IV. History of the Program

The program that is currently entitled Materials Science and Engineering originated as "Metallurgy" in the early 1950s and was an option within the Chemical Engineering program. The degree of Metallurgical Engineering was recognized by the Engineering Council for Professional Development in 1964. The Department of Materials Science and Engineering was created as a separate entity in 1985 and the undergraduate degree program was changed to Materials Science and Engineering in 1988.

V. Accreditation

The undergraduate program has been continuously accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (formerly ECPD) since 1964. The EAC of ABET is comprised of representatives from 28 professional and technical societies, and represents the views of approximately two million practicing engineers.

VI. Program Educational Objectives

The general educational objectives of the college of engineering are to prepare students to enter and continue the practice of engineering and/or to continue their education by study in graduate or professional schools. The following specific Materials Science and Engineering Program Educational Objectives were established in consultation with our students, faculty, potential employers, and alumni to assure that the overall objectives of the College are met, and that our students graduate with an undergraduate education that will sustain them for their lifetime.

Graduates will:

1. Apply knowledge of the fundamentals of physical and chemical sciences, mathematics, and engineering sciences in the practice of materials science and engineering or in advanced professional studies;

2. Design components, systems, or processes and/or select materials for specific applications with consideration of economic, safety, environmental, and social issues;

3. Use professional skills in such areas as communication, problem-solving, and experience in working in diverse teams, to the practice materials engineering in contemporary and global environs.

4. Use the general education component of their education for the appreciation of cultural and social values, for understanding the impact of engineering solutions on society, and for personal development.

VII. Program Outcomes

Specific program outcomes have been identified that support the Program Educational Objectives and the outcomes established by ABET, Inc. that articulate the expectations of industrial leaders.

Program Outcomes require a graduate to have demonstrated that he/she can:

1. Apply the fundamentals of physical and chemical sciences, mathematics, and engineering sciences to define and solve problems in materials systems;

2. Relate the role of composition, synthesis, and processing methods to structure and properties, and in turn to the performance in service of all classes of materials (metals, ceramics, polymers);

3. Integrate information from diverse sources to define and solve problems in materials selection and design and relate to system performance;

4. Effectively communicate orally and in writing;

5. Effectively contribute while working in teams;

6. Use statistical and computational methods for analysis, design, and communication;

7. Apply modern engineering tools to solve problems in materials systems;

8. Define problems, develop and evaluate technically feasible solutions from diverse knowledge bases, and implement solutions acceptable with regard to economical, environmental, and societal impact, and other contemporary issues;

9. Understand their professional and ethical responsibilities to society in a global context; and,

10. Understand the necessity of life-long learning.

The faculty have adopted a variety of strategies for helping students meet these outcomes and will use several techniques to assess your progress towards satisfactory demonstration of achievement. These strategies use both formal classroom instruction and extra-curricular activities as mechanisms for achievement.

VIII. Faculty

The Department of Materials Science and Engineering has an active faculty whose interest and expertise cover the broad spectrum of materials science and engineering. These interests and expertise cover all classes of materials (metals, ceramics, polymers, composites, electronic materials, and biomedical materials) and the areas of processing and synthesis, structure, properties and performance. With a low student-to-faculty ratio, the Department encourages one-on-one interactions among students and faculty.

Name	Office No.	Telephone (974- xxxx)	E-Mail Address

Professor and Head

George M. Pharr 425 Dougherty 8202 pharr@utk.edu
(MSE/ORNL Joint Faculty Member)
Ph. D. Materials Science and Engineering, Stanford 1979; Research Interests: Mechanical Behavior of Solids with emphasis on Nanoindentation Techniques, Mechanical Properties of Thin Films and Coatings.

Professors

Roberto S. Benson 427C Dougherty 5347 rbenson1@utk.edu
Ph.D Physical Chemistry, Florida State 1978; Research Interests: Biomedical Materials, Polymer Processing and Properties.

Gajanan Bhat 205 Tandec 0976 gbhat@utk.edu
Ph.D. GA. Tech, 1990; Research Interests: "Spunbond and Meltblown Nonwovens; High Performance Fibers, Natural Fiber-based Composites, and Plastics Recycling".

Randall Bresee 206 Tandec 0838 rbresee@utk.edu
Ph.D., Florida State 1979; Research Interests: Nonwoven Materials, Melt Blowing, Image Analysis.

Charlie R. Brooks
(Professor Emeritus) 306-ADougherty 5314 jbrooks@utk.edu
Ph. D. Metallurgical Engineering, Tennessee, 1962; Research Interests: Physical Metallurgy of Metallic Alloys and Iron Meteorites, Electron Microscopy, Calorimetry and Electrical Resistivity of Metallic Materials.

Edward Clark eclark2@utk.edu
(Professor Emeritus)
Ph.D. Chemistry, California-Berkeley 1956; Research Interests: Structure-property Relationships in Polymers, X-ray Diffraction, X-ray Crystallography.

Billie Collier Andy Holt Tower 2474 bcollier@utk.edu
Ph.D., UTK: Interim Associate Vice President for Research and Chief Research Officer.

Narendra Dahotre 326 Dougherty 3609 ndahotre@utk.edu
(MSE/ORNL Joint Faculty Member)
Ph.D., Michigan State, 1987; Research Interests: Ceramic Processing, Laser Materials Processing, Structure/Property Relationships.

Takeshi Egami 206 S. College 7204 egami@utk.edu
(MSE/ORNL Distinguished Scientist)
Ph.D., Pennsylvania 1971; Research Interests: Atomic Structure of Electronic Oxides including Superconducting, Ferroelectric, Catalytic, and Magnetic Oxides. Modeling of Structure. Neutron Scattering, Synchrotron X-ray Scattering.

John F. Fellers jfellers@utk.edu
(Professor Emeritus)
Ph. D. Polymer Science, Akron 1967; Research Interests: Processing of Thermoplastic Polymer Composites.

Easo George 426 Dougherty 9331 egeorge@utk.edu
(MSE/ORNL Joint Faculty Member)
Ph.D., Pennsylvania, 1985; Research Interest: Mechanical Behavior, Physical Metallurgy, Intermetallics, In-situ Composites.

Marion G. Hansen 325 Dougherty 5319 mghansen@utk.edu
Ph. D. Engineering Mechanics, Wisconsin-Madison 1974; Research Interests: Polymer Rheology, Polymer Processing and In-line Optical Spectrometry.

David C. Joy 232 Science & Eng. 3638 djoy@utk.edu
(Distinguished Scientist; Joint MSE and Biochemistry/Cellular and Molecular Biology)
Ph.D., Oxford (UK); Research Interests: Applications of Electron Diffraction and Microscopy.

Peter K. Liaw 427B Dougherty 6356 pliaw@utk.edu
(Ivan Racheff Chair of Excellence)
Ph. D. Materials Science and Engineering, Northwestern 1980; Research Interests: Nondestructive Evaluation and Mechanical Properties of Composites, Life Prediction Methodology for High Temperature Materials.

C. T. Liu 304 Dougherty 5567 cliu1@utk.edu
(Distinguished Research Professor)
Ph.D. Materials Science and Engineering, Brown University 1967; Research Interests: Physical metallurgy and mechanical behavior of metals, alloys, intermetallic compounds and bulk metallic glasses, and nanophase composites.s

Douglas H. Lowndes (part-time) ORNL dlowndes@utk.edu
(Corporate Fellow, Oak Ridge National Laboratory)
Ph. D., Colorado; Research Interests: Laser Deposition of Materials, Electronic Materials, Superconducting Materials.

Carl D. Lundin 307 Dougherty 5310 lundin@utk.edu
Ph. D. Metallurgical Engineering, Rensselaer Polytechnic Institute 1966; Research Interests:: Welding and Joining Metallurgy.

Carl J. McHargue 514 East Stadium Hall 7680 crl@utk.edu
(Director, Center for Materials Processing)
Ph. D., Metallurgy, Kentucky 1953; Research Interests: Ion Beam Modification of Ceramics, Surface Mechanical Properties, Nanostructures.

T. G. Nieh 422 Dougherty 5328 tnieh@utk.edu
(MSE/ORNL Joint Faculty Member)
Ph.D., Stanford, CA 1980; Research Interests: Superplasticity, Nano Materials, Composites.

Anthony J. Pedraza 306C Dougherty 7809 apedraza@utk.edu
Ph. D. Physics, La Plata (Argentina) 1974; Research Interests: Laser Processing and Characterization, Thin Film Deposition, Electronic Materials, Phase Transformations.

Mike Simpson 310 Dougherty 3316 simpsonml1@ornl.gov
(MSE/ORNL Joint Faculty Member)
Ph.D., Tennessee; Research Interests: Electronic Materials, Nanostructured Materials, Nanofabrication, Biomaterials

Joseph E. Spruiell 424 Dougherty 5327 spruiell@utk.edu
Ph. D., Metallurgical Engineering, Tennessee, 1963; Research Interests: Influence of Processing Parameters and Resin Characteristics on the Structure and Properties of Polymers.

Larry Wadsworth 204 Tandec 3572 lwadswor@utk.edu
Ph.D., Raleigh, NC, 1978; Research Interests: Nonwoven Materials, Process-Structure-Property Studies in Melt Blowing and Spunbonding and Composites Technologies

Associate Professors

Kevin Kit 510 Dougherty 7055 kkit@utk.edu
Ph.D., Delaware, 1997; Research Interests: Polymer Blends, Mechanical Behavior of Polymers and Polymer Composites, Polymer Crystallization, Polymer Processing, Electrospinning, Radiation Cured Resins

Thomas T. Meek 306D Dougherty 0940 tmeek1@utk.edu
Ph. D. Ohio State 1977; Research Interests: Microwave Processing of Materials, Ceramics Processing, Acoustic Processing of Materials.

James R. Morris
Ph.D. Cornell University, August 1992; Research Interests: Computational Materials Science

Philip D. Rack 603 Dougherty 5344 prack@utk.edu
Ph.D. Gainesville, Florida, 1977; Research Interests: Electronic and Optoelectronic Materials, Thin Film Processing and Characterization, and Selective Nanoscopic Processing

Assistant Professor

Hahn Choo 319 Dougherty 3643 hchoo@utk.edu
Ph.D., Illinois Institute of Technology, 1998; Research Interests: Physical/Mechanical Behavior of Advanced Structural Materials, Neutron Scatterings

Yanfei Gao
Ph.D., Princeton, New Jersey, 2003: Research Interests: Computational Materials Science.

Bin Hu 608 Dougherty 3946 bhu@utk.edu
(MSE/ORNL Joint Faculty Member)
Ph.D., Chinese Academy of Sciences, 1991; Research Interests: Electronic and Optical Polymeric Materials and Devices

Veerle Keppens 312 Dougherty 3494 vkeppens@utk.edu
Ph.D., Katholieke, Leuven, Belgium 1995; Research Interests: Solid State Physics/Physical Acoustics, Resonant Ultrasound Spectroscopy, Synthesis and Characterization of Novel Materials, Tunneling States in Amorphous Materials.

Claudia Rawn 609 Dougherty 5340 rawncj@ornl.gov
(MSE/ORNL Joint Faculty Member)
Ph.D., University of Arizona 1995; Research Interests: Ceramic Processing, In-situ X-Ray and Neutron Diffraction, Crystallography, Thermal Expansion

IX. Support Staff

The assistance of the department's support staff is important to the educational experience. Our staff members are eager to cooperate and help you when you need assistance or advice. Please call on them.

Name	**Office (Dougherty)**	**Phone (974-xxxx)**	**Functions**
Roberta Campbell	427-A	5304	Principal Secretary
Doug Fielden	106	5297	Technical Supervisor III
Danny Hackworth	106	4218	Design Technician
Frank Holiway	308	5264	Accounting Specialist II
Pat Houser	430C	2696	Accounting Specialist II
Greg Jones	330	5446	Elec. Microscope Technician
Carla Lawrence	434	5335	Administrative Support Assistant III
Sandra Maples	434	5336	Administrative Specialist II
Mike Neal	332	6839	Electronics Technician
Carolyn Nelson	430C	5338	Business Manager
David Stansberry	430C	4-0661	Accounting Specialist II
Larry Smith	106	4218	Technical Specialist III
Steve Stiner	331	6839	Electronics Shop Supervisor
Randy Stooksbury	308	5264	Administrative Support Assistant II
Carol Winn	106 SERF	0874	Design Technician

X. General Information

Address:	Department of Materials Science and Engineering 434 Dougherty Engineering Building University of Tennessee - Knoxville Knoxville, TN 37996-2200
Campus Mail Code:	2200
Main Office Phone:	(865) 974-5336
Fax Number:	(865) 974-4115
Computer Facilities:	314 Dougherty Engineering Building

XI. Academic Advising

Students are assigned a Departmental Advisor at the beginning of their Sophomore year. These advisors are specially chosen to be faculty that are usually available, have an interest in and are knowledgeable about the undergraduate program and have good rapport with students. All students must meet with these advisors each semester for a formal advising session. You are urged to contact your advisor as often as you need for advice and guidance. Do not wait until you are in trouble to see him or her!!

You will also get considerable informal advising from the newly established undergraduate seminar program, in which all undergraduate students will be enrolled every semester.

The following tools are used during the advising sessions:

Curriculum Worksheet
General Education Requirements
Undergraduate Catalog.

XII. The Undergraduate Program

The program leading to the Bachelor of Science in Materials Science and Engineering provides breadth and depth in the field with treatment of all classes of materials. The mathematics and basic science component provides a firm scientific base for understanding and application of engineering principles to materials systems. Additional engineering topics are covered to broaden the engineering perspective of materials engineers. A general education component provides a basis for understanding the impact of engineering solutions on society and the engineer's responsibilities to society. The general education component also expands your horizons for a rewarding personal life.

The Materials Science and Engineering faculty has established Learning Objectives for each course and will assess your progress toward achieving these objectives using techniques other than test scores. These Learning Objectives have been linked to the Program Educational Objectives and Program Outcomes.

The curriculum requires 128 semester hours of credit. See Appendix B for list of requirements.

The Program Educational Objectives of the Materials Science and Engineering Program articulate the need for understanding the economic, safety, environmental and social issues involved in designing components, systems or processes. Additionally, an understanding of the practice of engineering in contemporary and global environs is required. An important objective is also the enrichment of ones personal life. The achievement of these objectives very much relies upon the General Educational Component of the curriculum. The Learning Objectives and description of the Materials Science and Engineering courses are contained in Appendix A.

The University of Tennessee has established a university general education requirement that includes emphases upon building basic skills and developing broadened perspectives. These requirements apply to all undergraduate students and are listed at the front of the undergraduate catalog. Engineering students should consult with their advisor and carefully select General Education Electives to insure that (1) courses meet the general education needs of their program and (2) courses meet the university general education requirements. In addition to the university requirements, MSE students must also take Economics 201.

The requirement for three courses in writing communication may be filled by English 101 and 102 plus Materials Science and Engineering 405 (or other approved writing intensive course). The requirement for one course in communicating orally may be filled with Materials Science and Engineering 489 (or other approved communicating orally course). Graduation in materials science and engineering requires a minimum grade point average of 2.00 for all departmental courses.

XIII. Grades and Scholastic Requirements

Graduation in Materials Science and Engineering requires a minimum grade point average of 2.00 for all departmental courses.

A Lower Division student applies for Upper Division status after completing 50 semester hours of Lower Division engineering curriculum course work with an overall GPA of at least 2.4. This must include MSE 201. Lower Division courses generally carry 100 and 200 designations.

Students who have completed 50 semester hours of Lower Division engineering curriculum course work with an overall GPA between 2.0 and 2.4 may be admitted to the upper Division on a Provisional Status. Provisional students are required to demonstrate their ability to perform satisfactorily in upper division courses by attaining a minimum GPA of 2.0 in at least 8 hours of 300-level required courses in the department.

Transfer students are admitted to the Upper Division on a Provisional Status only.

The University requirements for grades and scholastic achievement are given in the Undergraduate Catalog.

The University requires that you register for a minimum of 12 semester hours in order to be classified as a full-time student. The maximum number of hours allowed by the College of Engineering without special permission is 19. The Associate Dean of Engineering, must give permission to take 20 hours or more.

XIV. Portfolios

The Materials Science and Engineering program uses student portfolios as one indication of your progress towards successfully completion of the program. Portfolios are simply an annotated compilation of examples of student work and activities that indicate progress to achievement of the desired Program Educational Objectives and Program Outcomes given in Sections IV and V of this Handbook.

A file with your name is maintained in the departmental office. You should place examples of your work in this file with a note of its contribution to a specific outcome. For example, a graded laboratory report may indicate demonstration of: (a) written communication skills; (b) use of modern engineering tools; (c) use of statistical and other computational skills in analyzing and interpreting experiments; and (d) team activities.

Your advisor will periodically review this file and use the information in the advising sessions. A copy will be given to you upon graduation.

XV. Ethics and Standards of Conduct

(See Honors Statement, Page 28)

The University of Tennessee-Knoxville is committed to maintaining an atmosphere of intellectual integrity and academic honesty. All students are expected to abide by the Standards of Conduct and Academic Honesty statements contained in the student handbook **Hilltopics**. All students are expected to abide by The University of Tennessee Honor Statement which reads: "**As a student of the University, I pledge that I will neither knowingly give nor receive any inappropriate assistance in academic work, thus affirming my personal commitment to honor and integrity**".

Faculty likewise are expected to treat all students with respect and to practice honorable and ethical dealings with each individual.

Engineers have special ethical and professional responsibilities in the practice of engineering. Our actions often have significant impact on the environment, safety, and economics of the society in which we live and work. These responsibilities will be emphasized in many of the courses.

The Code of Ethics adopted by the National Society of Professional Engineers is reproduced on the inside back cover of this Handbook. Please use it as a guide in your professional activities.

XVI. Professional Societies

ASM/TMS Joint Student Chapter: The University of Tennessee ASM/TMS Student Chapter is an organization that is affiliated with both ASM International and The Minerals, Metals, and Materials Society. The goals of each professional society is the promotion of materials science and engineering throughout the world through education and service. The student chapter has strong support by the departmental faculty and by the Oak Ridge Chapter of ASM International. The Oak Ridge Chapter invites all students to their monthly meetings which are rotated between Oak Ridge and Knoxville. The Oak Ridge Chapter also offers undergraduate and graduate scholarships. The Center for Materials Processing has established an Enrichment Fund that will pay the entrance fee and dues for the first year for entering students.

Society of Plastics Engineers Student Chapter (SPE): An active student chapter of the Society of Plastics Engineers also exists. This SPE student chapter is affiliated with the Smoky Mountain Section of the SPE. This section also invites and students to their monthly meetings.

XVII. Scholarships and Awards

College Scholarships: The College of Engineering offers a scholarships to outstanding students enrolled in the College of Engineering. Interested students should apply through the academic dean, Dr. Luther Wilhelm, 101 Perkins Hall.

MSE Departmental Scholarships: The Materials Science and Engineering Department has a number of scholarships which it makes available to students enrolled in the Materials Science and Engineering undergraduate program. Interested students may obtain application materials from the departmental office or by writing to the Department Head.

Appendix A
MSE Course Descriptions

101 Advances in Materials Science and Engineering (1)
Catalog Description:
Review modern advances in Materials Science and Engineering. Expose students to a variety of materials science and engineering case studies to demonstrate the societal impact of materials science and engineering profession. Satisfactory/No Credit grading only.

MSE 201 Introduction to Materials Science and Engineering
Learning Objectives: This course develops an introductory understanding of the atomic structure, crystalline structure and microstructure of solids. The student will learn the terminology and fundamental principles of materials structure and their related properties. The course introduces the student to mechanical, physical, and chemical properties which are of engineering significance. The course directly supports overall MSE program education outcomes 1, 2, 3, 4, 6 and 7. The laboratory associated with this course contributes to improved team work and communication skills of the student, program outcomes 4 and 5.
Catalog Description:
201 Introduction to Materials Science and Engineering (3)
Correlation of atomic structure, crystal structure and microstructure of solids with mechanical, physical and chemical properties of engineering significance.
Prereq: Chemistry 130. E.
Textbook: William D. Callister, Materials Science and Engineering, An Introduction, John Wiley & Sons, Inc., 6th Edition, 2003.
Topics: Chemical Bonding; Structure of Crystalline Solids; Imperfections in Solids Diffusion; Mechanical Properties of Metals; Dislocations and Strengthening Mechanisms; Failure of Materials; Phase Diagrams; Phase Transformations in Metals; Thermal Processing; Structure and Properties of Ceramics; Applications and Processing of Ceramics; Polymer Structures; Applications and Processing of Polymers; Composites
Laboratory Projects: Mechanical Properties of Metals; Cold Working and Annealing Correlation of Microstructure with Phase Diagram; Heat Treatment of Steels; Mechanical Behavior of Polymers

250 Introduction to Materials Kinetics and Transport Phenomena (4)
Catalog Description:
Mass and energy balances; reaction kinetics; steady state and transient heat transfer; viscous flow of gases and liquids; applications to synthesis and processing of engineering materials and technologies; analytical and numerical problem solving. 3 hours lecture, 1 hour lab. Prereq: Mathematics 142; Coreq: MSE 201, Mathematics 231.
Textbook: Fundamentals of Chemical Reaction Engineering, Mark E. Davis and Robert J. Davis, Hardback and Softback, McGraw-Hill, 2003, and Transport Phenomena and Materials Processing, Sindo Kou, John Wiley & Sons, Inc. Hardback, 1996.

260 Materials Engineering Thermodynamics (3)
Learning Objectives: The fundamental laws of thermodynamics are developed and applied to materials systems. Learning objectives are to prepare the student to 1) carry out simple thermochemical and thermodynamic calculations, 2) understand the physical significance of thermodynamic quantities such as internal energy, entropy, enthalpy, and free energy, and 3) understand the concept of thermodynamic equilibrium and the application to phase behavior, phase diagrams, and chemical reactions. The course directly supports overall MSE program education outcomes 1, 2, 6, and 7.
Catalog Description: Thermodynamic laws; entropy, internal energy, state functions; one- component and two-component phase equilibria; characteristics of small and large molecular systems; surface energy; elasticity; material defects. Prereq: Engineering Fundamentals 152, Chemistry 130, Mathematics 142. Coreq: 201

MSE 290, 291 Materials Seminar
Learning Objectives: This class provides sophomore Materials Science and Engineering students with information and considerations that are not covered formally in other undergraduate courses. The students are prepared for seeking employment, acquainted with industrial environments, and informed of the responsibilities of

materials scientists and engineers. The course contributes to the fulfillment of MSE program educational outcomes 4, 7, 9, and 10.

Catalog Description:

290, 291 Materials Seminar (1)
Professional and ethical considerations, safety, patents, products liability, field trips. Satisfactory/No Credit grading only.

Textbook: None. Selected articles pertaining to topics. Notes provided by seminar speakers.

Grading: Based on attendance and term paper.

Topics: Patents and Patent Law; Copyright Law; Ethics and the Responsible Engineer; Safety in the Laboratory; Safety in the Work Place; Product Liability; Job Placement; Careers in Materials; Library Utilization; MSE Curriculum & Elective Options; Plant Trips; Term Paper: Topics of current interest to the materials community and of interest to the student.

MSE 300 Materials Laboratory Procedures

Learning Objectives: The learning objectives of this course are to: (1) gain hands-on experience in conducting laboratory experiments involving fundamental principles in materials science and engineering, (2) understand the design of an experiment relative to the measuring and performance capabilities of a piece of equipment, (3) gain experience in analysis of data and writing reports in the accepted scientific format, and (4) take responsibility for a project and learn how to make an effective oral report on the project.The content directly supports MSE program education outcomes 2, 3, 4, 5, and 7.

Catalog Description:

MSE 300 Materials Laboratory Procedures (1) Hands-on sample preparation, characterization, and data analysis for introductory studies of crystal structures, microstructures, physical properties, and mechanical properties; Report writing skills including word processing and graphics usage; Oral presentation skills. Prereq: 201

Textbook:
G. F. Vandervoort, Metallography, Principles and Practice, McGraw-Hill, New York 1984.
W. D. Callister, Jr., Materials Science and Engineering – An Introduction, John Wiley & Sons, Inc.,

References: ASM Handbook Series

Topics: Report writing and presentation methods; Crystal Structure and X-Ray Diffraction; Microstructure and Optical Microscopy; Quantitative Analysis of Microstructure; Thermophysical Properties; Characterization and Hardness Measurements; Impact Test and Scanning Electron Microscopy; Data Analysis; Oral Presentations

Computer Usage: Word Processing, PowerPoint Presentation, Spread Sheets, and Graphics

301 Application of Statistical and Numerical Techniques in Engineering (3)
(See Chemical Engineering 301.)

Catalog Description:
Statistical methods for probabilities, expectations, sampling, and estimation; Numerical methods for regression, integration, solution of systems of linear/nonlinear algebraic and differential equations. Prereq: 215, Mathematics 142, or permission of instructor.

MSE 302 Mechanical Behavior of Materials I

Learning Objectives: This course covers the basic principles needed to understand deformation and fracture in solid materials including metals, ceramics, polymers and composites. Both materials and mechanics approaches are developed. The course directly supports overall MSE program education outcomes 1, 2, 6, and 7.

Catalog Description:

302 Mechanical Behavior of Materials I (3) Tensile testing of metals, ceramics and polymers; deformation mechanisms in the various materials, including crystalline and non-crystalline forms; rubber elasticity, viscoelastic behavior, creep, time-temperature superposition in polymers; fatigue. Prereq: 201,303, or consent of instructor.

Textbook: Dieter, Mechanical Metallurgy, 3rd ed., McGraw-Hill, 1986.

Topics: Stress and strain as tensor quantities; isotropic and anisotropic elasticity; anelastic and viscoelastic deformation; plasticity; tensile testing; mechanisms of plastic deformation in crystalline solids; basic strengthening mechanisms; elementary fracture mechanics.

Computer Usage: Word processing, graphics, curve fitting, equation solving, spread sheet analysis.

MSE 304 Principles of Materials Laboratory
Learning Objectives: The learning objectives of this course are to: (1) reinforce the students' classroom studies by having them conduct laboratory experiments involving fundamental principles in materials science and engineering, (2) improve the students' teamwork and communication skills by having them work in groups and submit formal laboratory reports, and (3) introduce the students to statistical analyses of experimental data. The course directly supports overall MSE program educational outcomes 1, 2, 4, 5, 6 and 7.
Catalog Description:
304 Principles of Materials Laboratory (1) Laboratory assignments demonstrating fundamental principles of materials science and engineering. Prereq: 201. Coreq: 322, 340, 360.
Textbook: None
References: Hand-out material. Students are required to use the library.
Laboratory Experiments (typically 5~6 experiments are selected from the list):
Segregation and Homogenization of Brass; Phase Diagram Determination by Thermal and Microstructural Analyses; Creep of Engineering Materials; Mechanical Properties of a Metal Matrix Composite; Fatigue Test and Thermography; Thermal Expansion Coefficients of Engineering Materials; Electrical Resistivities of Engineering Materials; Polymer Synthesis and Characterization; Dilute Solution Viscopsity; Film Casting of Polypropylene; Dynamic Mechanical Properties of Polypropylene Film; Fourier Transform Infrared Spectroscopy; Slip Casting of Ceramics; Synthesis and Characterization of Amorphous Alloy Powders
Computer Usage: Spreadsheets, graphics, word processing required.

MSE 320 Diffusion and Phase Transformations
Learning Objectives: The course is designed to provide both a qualitative and quantitative analysis of the kinetics of diffusion-controlled solid state phenomena and processes. It also develops the theory of phase transformations. It provides the basic background for analysis of commercial heat treatment, emphasizing the relationship between microstructure and mechanical properties. Microstructural techniques are used in the laboratory for the study of phase transformations. The course directly supports MSE program educational outcomes 1, 2, and 6.
Catalog Description:
MSE 320 Diffusion and Phase Transformations (4)
Introduction to diffusion in solids; the diffusion equations, point defects and atomic mechanisms of diffusion. Thermodynamics of phase equilibrium. Introduction to the kinetics and morphology of phase transformations. Prereq: MSE 201.
Textbook: D. A. Porter and K. . Easterling, Phase Transformations in Metals and Alloys, 2d ed., Chapman and Hall, 1992.
Topics: The diffusion equations; Solution of Fick's equation for one-dimensional diffusion problem; Substitutional diffusion - Kirkendall effect, driving force for diffusion; Thermodynamic concepts; Atomic mechanisms of diffusion - metals and ceramics; Thermodynamics of interfaces - surface tension and surface free energy; Structure of interfaces; Thermodynamics of phase equilibrium; Nucleation; Solidification; Thermally-activated growth in metals and ceramics; Martensitic transformations.
Computer usage: Spreadsheets, graphics, programming and work processing.

MSE 340 Principles of Polymeric Materials
Learning Objectives: This course provides an introduction to the field of polymer science and engineering. The unique macromolecular nature of polymers and the diversity of molecular structures are presented.The mechanisms and methods by which these structures are synthesized, the polymerization kinetics, and the statistical nature of the polymeric products are developed by drawing on the student's background in chemistry and mathematics. The properties of these materials in solution and the solid state including phase equilibria, molecular conformations, crystalline order, and mechanical and thermal properties are explained on the basis of their molecular structure and in conjunction with techniques to measure these properties. Aspects of polymer rheology and various processes which render these materials in desired and practical forms are presented. The course contributes to the fulfillment of MSE program educational outcomes 1, 2, 3, and 4.
Catalog Description: 340 Principles of Polymeric Materials (3) Synthesis and molecular structure of polymers; polymerization kinetics; molecular characterization; crystalline and glass transitions; crystallization kinetics, mechanical properties; rheology and processing. Prereq: MSE 201. F.
Textbook: J. L. Fried, Polymer Science and Technology, Prentice-Hall PTR, 1995.
Topics: Introduction: Definitions, Classifications of Polymers, Molecular Structure; Synthesis: Mechanisms, Kinetics, Techniques; Solution Properties: Solution Thermodynamics, Phase Equilibria, Measurement of Molecular Weight, Polymer Characterization; Solid State Properties: Crystalline Order, Crystalline and Glass

Transitions, Crystallization Kinetics, Mechanical Properties; Viscoelasticity: Linear Viscoelasticity, Time-Temperature Superposition; Rubber Elasticity: Statistical Theory; Polymer Processing: Process Operations, Rheology, Rheometry; Network Polymers

MSE 350 Principles of Electronic, Optical, and Magnetic Materials (3)
Catalog Description:
Fundamental electronic, optical, and magnetic properties of solid state materials. Basic bonding and crystallography correlations to electronic, optical, and magnetic properties of materials. Specific subjects that will be covered include: wave properties of electrons, Schrodinger's equation, energy bands in crystals, electrical conduction in metals and semiconductors, classical and quantum mechanical treatments of optical properties, and magnetic phenomena. Prereq: 201.

MSE 360 Principles of Ceramic Materials
Learning Objectives: This course develops a knowledge of the atomic crystal structure of ceramic materials and glasses. Understanding the idea atomic structures allows defect structures and phase equilibria of binary and ternary ceramic systems to be introduced. In addition to the atomic structure and its relation to properties the link between processing and microstructure and the resulting properties is introduced. The course directly supports Educational Outcomes 1, 2, 4, 5, 6, 7, 9, 10.
Catalog Description: 360 Principles of Ceramic Materials (3). Description of complex crystal structures containing both cations and anions with polyhedral building blocks. Features, operations, and reaction paths for heating and cooling of ternary phase diagrams. Discussion of defects and Kröger-Vink notation. Solid-state synthesis of ceramics.
Textbook: Fundamentals of Ceramics, Michel W. Barsoum, Institute of Physics (2002).
Topics: Basics of atomic crystal structures of ceramics and glasses. Crystal structure of important ceramic materials and the correlation to physical properties. Defect structures and the use of Kröger-Vink notation to describe defect chemical reactions. Features and operations of ternary phase diagrams of ceramic systems. Relating processing parameters to resulting microstructures.

MSE 370 Materials Processing
Learning Objectives: This course demonstrates the application of basic science principles to the processing of all classes of materials and their conversion to useful products. Production of bulk materials, fibers, films and coatings by processes such as casting, molding, extrusion, forging, powder techniques, and various coating procedures will be treated. This course directly supports MSE Educational Outcomes 1 and 2.
Catalog Description: 370 Materials Processing (3) Application of fundamentals of mass and energy balances, mechanics, heat transfer, chemical thermodynamics and kinetics to the processing of materials and manufacturing of products. A wide ranfe of materials (metals, ceramics, polymers), geometries (bulk, fibers, films, coatings) and processes (casting, molding, extrusion, forging, powder processing, coating techniques, etc.) are studied as examples of processing technologies. Elementary ideas of process measurement and control. Prereq. 201, 320, ChE 200 and ChE 240, or equivalent.

390 Principles of Metallic Materials (3)
Catalog Description:
Property control through composition, mechanical and thermal processing; ferrous and nonferrous alloys; alloy selection. Prereq: 201.

MSE 405 Structural Characterization of Materials
Learning Objectives: This course develops the fundamental understanding of the interaction of x-rays and electrons with matter and imparts an ability to apply this understanding to characterize crystal structure, microstructure and chemistry of engineering materials. The course introduces the student to diffraction techniques and to modern microanalytical techniques. The student will learn the terminology and fundamental principles of crystallography, powder techniques for determining crystal structure and phase analysis, techniques for measuring preferred orientation and crystallite size, and chemical analysis by x-ray fluorescence; and will be introduced to microstructural examination by scanning and transmission electron microscopy and to other microanalytical techniques. The course directly supports MSE program educational outcomes 1, 2, 3, 4, 5, and 7.
Catalog Description: 405 Structural Characterization of Materials (4) X-ray diffraction, X-ray fluorescence analysis, scanning and transmission electron microscopy, microanalytical techniques. 4 hr. or 3 hr. and 1 lab. Prereq: MSE 201.

Textbook: B. D. Cullity, Elements of X-ray Diffraction, 2nd Ed., Addison-Wesley, 1978 plus supplementary class notes.
Topics: The nature of X-Rays and their Interaction with matter; Geometry and Symmetry of Crystals; Bragg's Law and the directions of Diffracted Beams; The reciprocal Lattice; Diffraction Techniques with emphasis on Powder Techniques; Film Diffractometer and Spectrometer Techniques; Intensities of Diffracted Beams;
Crystal Structure Analysis; Precision Lattice Parameter Measurements; Phase Identification and Chemical Analysis by Diffraction X-ray Fluorescence Analysis; Scanning Electron Microscopy and Microanalytical Techniques;
TEM and Electron Diffraction Techniques
Computer Usage: Spreadsheets, Graphics, Word Processing required. Programming used by some
Laboratory experiences: Measurement of continuous and characteristic spectra emitted from an x-ray tube; Measurement of the mass absorption coefficient of a material, e.g. aluminum; Analysis of powder diffraction patterns-indexing, phase mixtures, lattice parameter variation for solid solutions; Verification of simple crystal structure (such as CU_20, CaF2, MgO, etc.) by comparing experimental and computed diffraction intensities, computation of best value of lattice parameter; Phase identification from powder diffraction pattern and JCPDS X-Ray Powder Data File;Measurement of preferred orientation in polymers;Use of scanning electron microscopy and microanalysis by x-ray spectroscopy to characterize materials

MSE 410 Theory and Processing of Electronic Materials
Learning Objectives: This course is an introduction to the physical properties and material processing of semiconductor devices. The first part of the course introduces the student to the basic properties of semiconductors and their transport properties. In the second part the acquired concepts are applied to the understanding of the physics and characteristics of semiconductor devices. A detail analysis and discussion are made of p-n junctions, which are the building blocks of most semiconductor devices. The bipolar and unipolar devices are covered next. Crystal growth, oxidation and film deposition, and diffusion and ion implantation are materials processing issues addressed during the development of the course. The course directly supports overall MSE program education outcomes 1, 2, 3, and 7.
Catalog Description: 410 Theory and Processing of Electronic Materials (3) Energy Bands and Carrier Concentration in Semiconductors. Transport Properties. p-n Junctions and Bipolar Devices. Unipolar Devices: JFET, MESFET, MOS, and MOSFET. Materials Processing of Electronic Devices. Prereq. MSE 201, Physics 232.
Textbook: S. M. Sze, Semiconductor Devices - Physics and Technology-, John Wiley & Sons, (1985).
Topics: Energy Bands and Carrier Concentration; Transport Phenomena; p-n Junction; Bipolar Devices-Transistors;
Unipolar Devices; Metal Semiconductor Contacts; The Junction Field-Effect Transistor (JFET); The Metal-Semiconductor Field-Effect Transistor (MESFET); The Metal-Oxide-Semiconductor Device (MOS); The Metal-Oxide-Semiconductor Field-Effect Transistor (MOSFET); Crystal Growth; Doping of Semiconductors: Diffusion and Ion Implantation; Oxidation of Semiconductors; Deposition of Insulating Films
Computer Usage: Spreadsheets, Graphics and Word Processing required.

MSE 421 Mechanical Behavior of Materials II
Learning Objectives: The learning objective of this course is to gain fundamental understanding of the topics related to the mechanical behavior of structural materials including the dislocation theory, plastic deformation at ambient and elevated-temperatures, strengthening mechanisms, and fatigue. This course supports overall MSE program educational outcomes 1, 2, 3, and 6.
Catalog Description: **421 Mechanical Behavior of Materials II** (3) Dislocation theory, deformation by slip, twinning, strengthening mechanisms, fatigue, and time-dependent behavior. Prereq: 302 or consent of instructor.
Textbook: George E. Dieter, Mechanical Metallurgy, 3rd ed., McGraw-Hill
References:
1. Richard W. Hertzberg, Deformation & Fracture Mechanics of Engineering Materials, 4th ed., Wiley.
2. Thomas H. Courtney, Mechanical Behavior of Materials, 2nd ed., McGraw-Hill

Topics: Dislocation Theory; Plastic Deformation by Slip; Twinning; Strengthening Mechanisms; Elevated-Temperature Deformation Behavior; Fatigue; Deformation of Non-crystalline Materials.
Computer Usage: Spreadsheets and word processing required.

429 Introduction to Ceramic Matrix Composites (3)
__Catalog Description:__
Characteristics of composites, including ceramic matrix composites; macromechanics and materials design; overview of fabrication techniques; microstructural characterization; physical and mechanical property evaluation; current and potential applications. Prereq: 201, Engineering Science 321, or equivalent.

MSE 445 Polymer Engineering Processing and Characterization Laboratory (3)
__Learning Objectives__: The objectives of this course are to provide a fundamental understanding of polymer processing. This is a survey course in polymer processing with description of the physical, thermal, mechanical, and Theological properties of polymeric materials relevant to their processing behavior. Review of the basic transport phenomena equations: mass, momentum, and energy. Analysis of various processing operations for the manufacture of polymeric articles, with particular emphasis on: extrusion, injection molding, blow molding, thermoforming, fiber spinning, and compression molding. Discussion of plastics recycling issues. This course contributes to MSE program education outcomes 1, 2, 3, 4, 7 and 10.
__Catalog Data__: Polymer film casting, film blowing, mixing and extrusion are operated and studied. Flow rates, temperatures, pressures and velocity profiles are acquired and used in finite element modeling and simulation to correlate the polymeric material properties and morphology. Supporting instrumentation includes linear viscoelastic rheometry, capillary viscometry, SEM, OM, FTIR, etc. Coreq: 201 and/or consent of instructor.
__Text__: J.F. Agassant, Introduction to Polymer Processing, Hanser, 1992
__Topics__: Structure of plastics; Properties of plastic Flow of viscous fluids; Non-Newtonian fluid;s
Energy Equation; Extrusion (melting conveying); Extrusion (melting); Mixing; Die design; Injection molding; Compression molding; Processing of Reactive Polymers; Thermoforming and blow molding; Recycling
__Computer Usage__: Homework assignments dealing with extruder design, die design and material property characterization. Material properties will be obtained from databases and World Wide Web with analysis being done with the desktop software, MATLAB
__Laboratory Projects__: Capillary Viscometer Experiment (single screw extruder, capillary die and pressure transducer); Extrusion Experiment (single screw extruder and variable thickness sheeting die); Mixing Experiment (single screw extruder with transparent barrel)

MSE 470 Environmental Degradation of Materials
__Learning Objectives__: The learning objectives of this course are to (1) develop an understanding of the fundamentals associated with corrosion processes, and (2) relate this knowledge to current corrosion-measurement techniques and engineering design principles for corrosion control. The course directly supports overall MSE program educational outcomes 1, 2, 3, 4, 5, 7 and 8.
__Catalog Description__: 470 Environmental Degradation of Materials (3) Mechanisms, measurement techniques and control of environmental degradation processes in metals, polymers, ceramics and composites; materials selection and design considerations. Prereq: 201. Recommended for chemical engineering, mechanical engineering, civil engineering and engineering science and mechanics majors
__Textbook__: E.E. Stansbury and R. A. Buchanan, __Fundamentals of Electrochemical__ Corrosion, ASM International, Materials Park, Ohio, 2000.
__Topics__: Introduction and overview of aqueous corrosion; Electrochemical thermodynamics, including Pourbaix diagrams; Kinetics of single half-cell reactions; Kinetics of coupled half-cell reactions; Corrosion of active-passive type metals and alloys; Electrochemical corrosion-rate measurements; Localized corrosion, stress-corrosion cracking and corrosion fatigue; Degradation of polymers; Degradation of ceramics; Student team-design projects with oral presentations and written reports
__Computer Usage__: Programming used by some students.

MSE 472, ESM 426 - Fundamental Principles of Composite Materials
__Learning Objectives__: This course develops the fundamental understanding of design, fabrication, and analysis of fiber reinforced composite materials. The course covers various interdisciplinary aspects of polymer composites, such as: chenmical structure of fibers and its effect on mechanical properties of fibers; physical and mechanical properties of fibers and its affect on composite properties, chemistry of various polymer matrices and its significance on fiber-matrix bonding; composite manufacturing methods; mechanical testing and characterization methods; micro-mechanics and macro-mechanics; stress analysis; failure prediction, etc. In the Part B of the course, a special emphasis is placed on the fact that anisotropy of composite materials can be utilized as an additional tool for an efficient structural design. The laboratory portion of the course is only a demonstration of

some simple fabrication and testing methods. The course directly supports MSE program educational outcomes 1, 2, 3 and 4.
Catalog Data: ESM 426, MSE 472: Fundamental Principles of Composite Materials (3). Establishment of physical principles basic to design, manufacture and application of fiber reinforced polymers, metals and ceramics. Prerequisite: MSE 302 or equivalent
Text Book: Robert F. Jones, Mechanics of Composite Materials, Scripta Book Company
Prerequisite by Topics: Mechanics of Materials Mechanical Properties of Solids; Matrix Algebra, Vectors and Tensors
Topics: Elements of Composite Materials [Introduction: What are composite materials; composites versus conventional materials; advantages and disadvantages of composite materials; classification of composite materials (2); Properties of Fibers and Whiskers: Theoretical strength of solids; types of fibers (2); Properties of Matrix Materials: Purpose of matrix material, types of matrix materials (2); Fiber-Matrix Interface: Role of interface in polymer matrix, metal matrix and ceramic matrix composites; theories of adhesion; methods of interface characterization (3); Fabrication of Composite Materials: Fabrication of thermosetting and thermoplastic resin matrix composites (2)] Methods of Analysis [Generalized Hooks, Law: anisotropic, monoclinic, orthotropic, tetragonal, transversely isotropic, cubic and isotropic materials (3); Analysis of an Orthotropic Lamina (3); Strength of an Orthotropic Lamina (3); Micromechanics of a Composite Lamina (3); Mechanisms of Load Transfer from Matrix to Fiber (2); Macromechanical Behavior of Multidirectional Composite Laminate (4)
Examinations: 2 periods and a final examination
Laboratory Usage: Demonstration of composite laminate manufacturing process using the vacuum hot press; Demonstration of composite testing and interface testing methods (1)

MSE 474 Biomaterials
Learning Objectives: This course develops the understanding of the interaction between materials and human biological environment. The course introduces students to the principles of materials science and engineering involved in the selection, design, and assurance of long and short-term function of materials for medical applications. The students will learn the fundamental principles involved in the interaction of biomedical materials (metals, polymers and ceramics) with cells. tissue and blood. Students will be introduced to the requirements for implantable materials. A discussion on soft tissue (cardiovascular, ophthalmic, and wound closure) and hard tissue (orthopedic and dental) medical implant devices will be presented. Students will conduct a meaningful design project utilizing the acquired knowledge. This course directly supports overall MSE program educational outcomes 1, 2, 3, 4, 5, 8, 9, and 10.
Catalog Description: 474 Biomaterials (3) Metals, polymers and ceramics utilized in orthopedic, cardiovascular, and dental surgical implant devices; corrosion and degradation problems; materials properties of primary importance; tissue response to synthetic materials. Prereq: 201. Recommended for engineering science and mechanics majors.
Textbook: Biomaterials Science: An Introduction to Materials in Medicine, B. D. Ratner, A. S. Hoffman, F. J. Schoen and J. E. Lemons (eds.), Academic Press, 1996.
Topics: Tissue Response to Implants: Would-Healing Process, Complement Activation; Blood Compatibility. (2); Metallic Implant Materials: Stainless Steels, Co-Base Aloys, Ti and Ti-Base Alloys, other Metals, Mechanical Properties, Microstructures, Corrosion Fundamentals, Corrosion of Metallic Implant Materials. (8); Ceramic Implants. (2); Hard Tissue Replacement Implants: Fracture Fixation Devices, Joint Replacements, Dental Implants, Design and Function. (5); Polymeric Implant Materials: Polymerization, Structure and Properties, Biodegradation of Polymers. (7); Wound Closure: Sutures and Adhesives. (2); Soft Tissue Rplacement Implants: Synthetic Skin; Maxillofacial, Ear and Eye Implants. (3); Vascular and Heart implants. (3); Artificial Kidney. (2); Blood Oxygenators (2)

476 Overview of Intermetallic Compounds and Composites (3)
Catalog Description:
Fabrication and processing, ultrafine-grained materials nanotechnology, thermodynamics and stability, microstructural characterizations, mechanical properties, corrosion and oxidation properties, theoretical modeling, and design and industrial applications of intermetallics and composites. Laboratory demonstrations and group projects. Prereq: 201.

MSE 480 Materials Selection In Design
Learning Objectives: The role of materials in design has been receiving specialized attention in recent years. The state of development of the subject is such that the organization of the tools to deal with this very broad and

important problematic area now permits a somewhat systematized approach to the subject. The availability of usable computer data bases in association with material property maps and material design indices, provide a viable approach to materials design that is available now and will develop further with time. The current course provides instruction in a system of material selection mostly independent of the need to have extensive knowledge of the microstructural details of a material. The associated data base utilized includes the properties of polymers, light alloys, copper alloys, metal matrix composites, conductors, foams, and ferrous metals. In addition, supporting software is called to the students attention. This course supports program educational outcomes: 1, 2, 3, 4, 5, 7, and 8.
Catalog Description: MSE 380 Materials Selection In Design (3) Systematic materials selection in design. Review of material properties; use of property selection charts and indices. Materials selection, with and without shape constraints; materials processing in design; case studies. Sources of material property data, utilization of material data bases Industrial design, aesthetics, economics, regulations, forces for change.
Prerequisites: Junior standing
Textbook: Materials Selection in mechanical Design W. Charts, 3rd ed. Butterworth Hyman, 2005.
Topics: The design process, types of design; Engineering Materials and their properties; Review of relevant properties (Engineering Mechanics and failure modes); Materials selection charts, classes; Material selection without shape, performance indices; Case studies; Selection of material and shape and case studies; Materials processing and design process attributes and case studies; Sources of material property data; Use of material data sources; Materials, Aesthetics and Industrial Design; Forces of Change; Class design project employing concepts and Data Bases; Presentations.

Computer Data Base: Cambridge Materials Selector Version, for Windows™ Operating system, is the Data Base associated with the text.
Software: Internet Packages, ASM DATA Bases

484 Introduction to Maintainability Engineering (3) *(See NuclearEngineering 484)*
Catalog Description:
of maintenance and reliability engineering, and maintenance management. Topics include information extraction from machinery measurements, rotating machinery diagnostics, nondestructive testing, life prediction, failure models, lubrication oil analysis, establishing a predictive maintenance program, and computerized maintenance management systems. Prereq: Senior standing in engineering and consent of instructor

MSE 489 Materials Design
Learning Objectives: This course is considered the capstone experience in the undergraduate program where the student brings together their fundamentals and laboratory practice skills to solve a major design or failure analysis problem. Students undertake a semester-long project under the tutelage of a professor or post doctoral researcher and prepare a technical report and make a presentation of the results. The course directly supports the MSE program education outcomes 1, 2, 3, 4, 5, 6, 7, and 8.
Catalog Description: MSE 489 Materials Design (3) Design projects involving materials selection and performance.
Prereq: Senior Standing
Textbook: Materials Selection In Mechanical Design, M. F. Ashby, Butterworth-Heinmann, 1999.
References: ASM Handbook Series, Previous Course Texts.
Topics: Report Writing and Presentation Methods; In-Depth Projects Involving Material Design and Failure Analyses.
Computer Usage: Word Processing, Spread Sheets and Graphics.

MSE 494 Special Project Laboratory
Learning Objectives: This elective course allows undergraduates the opportunity to tackle a special project either individually or in a group environment. This course contributes to MSE program educational outcomes 3, 4, 5, 7, 8, and 10.
Catalog Data: 494 Special Project Laboratory (1-3) Group or individual investigation of problems related to materials science and engineering. May be repeated to a maximum of 6 credits. Prereq: 201, 202, 203 and prior arrangement of a professor.
Textbook: None
Goals: This course provides flexibility for students to pursue special projects of a research or development nature. Students may work independently or as a team to solve either short-range or long-range problems requiring significant investigation and analysis.

Topics: Projects provided by professors.

MSE 495 Thesis
Learning Objectives: This elective course allows students the opportunity to carry out and do their own research. This course contributes to MSE program educational outcomes 3, 4, 7, 8, and 10.
Catalog Data: 495 Thesis (3) Investigation and report on a research problem in materials science and engineering. By prior approval of a professor. May be repeated once. Prereq. Senior standing or consent of professor.
Textbook: None
Goals: This course provides opportunities for students to do independent research projects under the direct supervision of a professor.
Topics: Available research projects.

APPENDIX B
Bachelor of Science
Materials Science and Engineering

Semester 1		Semester 2	
English 101; Composition	(3)	English 102; Composition	(3)
Chemistry 120; General Chemistry	(4)	Mathematics 142; Calculus II	(4)
Mathematics 141; Calculus I	(4)	EF 152; Fund. Of Engr. Mechanics	(4)
EF 151; Engineering Approaches	(4)	Chemistry 130; General ChemistryII	(4)
EF 105; EF Laboratory	(1)	MSE 101; Advances in MSE	(1)

Semester 3		Semester 4	
MSE 290; Materials Seminar	(0)	MSE 291; Materials Seminar	(1)
MSE 201; Intro. MSE	(3)	Mathematics 200; Matrix Comp.	(1)
Mathematics 241; Calculus III	(4)	Mathematics 231; Diff. Equations	(3)
Physics 231; Elect. & Mag.	(4)	Physics 232; Waves, Opt., Modern	(4)
MSE 260; Materials Thermo	(3)	MSE 250; Kinetics and Transport	(4)
General Education Elective [1]	(3)	General Education Elective [1]	(3)

Semester 5		Semester 6	
MSE 300; Materials Laboratory	(1)	MSE 304; Prin. Materials Lab.	(1)
MSE 301;Data Analysis	(3)	MSE 390 Prin. Of Metallic Mat.	(3)
MSE 320; Diffusion & Phase Trans.	(3)	MSE 360; Principles of Ceramics	(3)
MSE 302; Mech. Beh. Of Materials	(3)	MSE 340 Prin. Of Polymeric Mat.	(3)
MSE 370; Materials Processing	(3)	MSE 350; prin. Elec. & Opt. Mat.	(3)
General Education Elective[1]	(3)	Technical Elective 2,3	(3)

Semester 7		Semester 8	
MSE 4XX	(3)	MSE 402; Fund. of Engineering	(1)
MSE 405; Structural Characterization	(3)	MSE 4XX	(3)
MSE 480; Mat. Selection in Design	(3)	Technical Elective	(3)
General Education Elective	(3)	MSE 489; Mat. Design	(3)
EE 301; Circuits	(3)	General Education Elective [1]	(3)
		General Education Elective [1]	(3)

* General Education Electives must include Economics 201. These courses must also satisfy the new General Eucation requirements effective in the 2005-2006 catalog. **Chemistry 350, Organic Chemistry, is strongly recommended for those students primarily interested in polymeric materials.
*** ME 321 is strongly recommended to help prepare students for the FE exam.

****MSE 4XX Elective is chosen from the following:

410 Electronic Devices (3)	470 Environmental Degrad. Of Mats (3)	494 Special Projects Lab (3)
421 Mech. Behavior II (3)	472 Fund. Prin. Composite Mats (3)	495 Thesis (3)
429 Intro. Ceramic Mtr. Composites (3)	474 Biomaterials (3)	
445 Polym. Eng. & Sci. Laboratory (3)	484 Intro. Maintenance Eng. (3)	

WORKSHEET
MATERIALS SCIENCE AND ENGINEERING UNDERGRADUATE CURRICULUM
Effective: Fall, 2005

Term								Semester Hours
FRESHMAN YEAR – FALL	Eng.101 (3) English Composition	Chem. 120 (4) General Chemistry	Math 141 (4) Calculus I	EF 151 (4) Engineering Approaches	EF 105 (1) EF Laboratory			16
SPRING	Eng.102 (3) English Composition	Math 142 (4) Calculus II	EF 152 (4) Fund. of Engr. Mechanics	Chem 130 (4) General Chemistry II	MSE 101 (1) Advances in MSE			16
SOPHOMORE YEAR - FALL	MSE 290 (0) Materials Seminar	MSE 201 (3) Intro. to MSE	Math 241 (4) Calculus III	Physics 231 (3) Electricity & Magnetism	MSE 260 (3) Materials Thermo (3	Gen. Ed. (3)[1] Elective		17
SPRING	MSE 291 (1) Materials Seminar	Math 200 (1) Matrix Computations	Math 231 (3) Differential Equations	Physics 232 (4) Waves, Optics, & Mod. Phys.	MSE 250 (4) Kinetics and Transport)	Gen. Ed. (3)[1] Elective		15
JUNIOR YEAR - FALL	MSE 300 (1) Materials Lab Procedures	MSE 301 (3) MSE Data Analysis	MSE 320 (3) Diffusion and Phase Trans.	MSE 302 (3) Mech. Beh. Of Materials	MSE 370 (3) Materials Processing	Gen. Ed. (3)[1] Elective		16
SPRING	MSE 304 (1) Prin. of Materials Lab	MSE 390 (3) Prin. Of Metallic Mat	MSE 360 (3) Prin. of Ceramic Mat.	MSE 340 (3) Prin. of Polymeric Mat	MSE 350 (3) Prin. Elec & Opt Mat. (3)	Technical Elective (3)[2,3]		16
SENIOR YEAR - FALL	.MSE 4XX (3)	MSE 405 (4) Structural Char. of Materials	MSE 480 (3) Mat. Selection in Design	Gen. Ed. (3)[1] Elective	EE 301 (3) Circuits			16
SPRING	MSE 402 (1) Fundamentals of Engineering	MSE 4XX (3)	Technical Elective (3)[3]	MSE 489 (3) Mat. Design	Gen. Ed. (3)[1] Elective	Gen. Ed. (3)[1] Elective		16
							Total	128

1. General Education courses must include Economics 201. These courses must also satisfy the new General Education requirements effective in the 2005-2006 catalog.
2. Chem. 350, Organic Chemistry, is strongly recommended for those students primarily interested in Polymer Engineering.
3. ME 321 is strongly recommended to help prepare students for the FE exam.

MSE 4XX Electives

410 Electronic Devices (3)
421 Mech. Behavior II (3)
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472 Fund. Prin. Composite Mats (3)
474 Biomaterials (3)
484 Intro. Maintenance Eng. (3)
494 Special Projects Lab (3)
495 Thesis (3)

HONOR STATEMENT
(From the 2005- 2006 Catalog)

All facets of the University community have responsibilities associated with the Honor Statement. These responsibilities are unique to each sector of the University community.

Each student is responsible for his/her own personal integrity in academic life. While there is no affirmative duty to report the academic dishonesty of another, each student, given the dictates of his/her own conscience, may choose to act on any violation of the Honor Statement. Each student is responsible for knowing the terms and conditions of the Honor Statement and may acknowledge his/her adherence to the Honor Statement by writing "Pledged" and signing each graded class assignment and examination.

Students are also responsible for any acts of plagiarism. Plagiarism is using the intellectual property of someone else without giving proper credit. The undocumented use of someone else's words or ideas in any medium of communication (unless such information is recognized as common knowledge) is a serious offense, subject to disciplinary action that may include failure in a course and/or dismissal from the University.
Specific examples of plagiarism are:

- copying without proper documentation (quotation marks and a citation) written or spoken words, phrases, or sentences from any source;
- summarizing without proper documentation (usually a citation) ideas from another source (unless such information is recognized as common knowledge);
- borrowing facts, statistics, graphs, pictorial representations, or phrases without acknowledging the source (unless such information is recognized as common knowledge);
- collaborating on a graded assignment without instructor's approval;
- submitting work, either in whole or part, created by a professional service and used without attribution (e.g., paper, speech, bibliography, or photograph).

Faculty members also have responsibilities which are vital to the success of the Honor Statement and the creation of a climate of academic integrity within the University community. Each faculty member is responsible for defining, in specific terms, guidelines for preserving academic integrity in a course. Included in this definition should be a discussion of the Honor Statement. Faculty members at their discretion may also encourage their students to acknowledge adherence to the Honor Statement by "pledging" all graded class assignments and exams. The form of pledge may include writing the honor statement on the assignment, signing the printed statement, or simply writing "Pledged." Additionally, it will be the responsibility of each faculty member, graduate teaching assistant, and staff member to act on any violation of the Honor Statement. It is also incumbent upon faculty to maintain an atmosphere conducive to academic integrity by insuring that each quiz, test, and exam is adequately proctored.

THE STATEMENT

An essential feature of the University of Tennessee is a commitment to maintaining an atmosphere of intellectual integrity and academic honesty. As a student of the University, I pledge that I will neither knowingly give nor receive any inappropriate assistance in academic work, thus affirming my own personal commitment to honor and integrity.