In future years, structural materials and processes in aerospace, power, marine, engine and other mechanical and chemical propulsion applications will have to meet the challenges of reaching new heights of efficiency and service life. In this context, engineers must be prepared to better handle the industrial and technological challenges specifically to engineer novel materials and predict their failures due to deterioration. However, the ability to improve the efficiency by engineering and designing can only be derived from the knowledge of structure-property relationships and deterioration mechanisms of a wide range of engineering materials, specifically those as encountered by mechanical engineers in the industry. This course is intended and designated to prepare the mechanical engineers with a broad knowledge and skill set in the topical area of structure and properties of engineering materials. Specifically, students will explore the fundamentals of engineering materials, which include simple metals to advanced ceramics and composites, and their properties. By learning the course contents, students will be able to answer questions for selection of engineering materials in terms of property requirement, processes involved, prediction of service life, and cost and efficiency.
Course Objectives

* Introduce various types of engineering materials that are most common to the mechanical engineers in the industry

* Develop familiarity with materials’ structure, properties and phenomena for efficient designing
MECH 2331  Instructor: Dr. Ramana  Spring, 2023

* Discuss the structure-property relationships in understanding the mechanical and thermal properties of a wide variety of materials so as to enable to students to choose certain type of materials for a given technological application

* Discuss options to further increase the efficiency, reduce costs, and establish the environmental safety

Topics Covered

The topics covered in this class are divided into three sections.

Section – I: Materials Science & Engineering
1. Introduction to Engineering Materials & Manufacturing
2. Structure & Crystal Imperfections
3. Diffusion – Multicomponent Mechanical Systems
4. Phase Diagrams

Section – II: Mechanical & Thermal Properties
5. Mechanical Properties – Part I (Strength)
6. Mechanical Properties – Part II (Fracture)
7. Thermal Properties
8. Mechanics of Corrosion and Wear

Section – III: Manufacturing
9. Casting
   A. Processes
   B. Phenomena – Solidification, Shrinkage and Recrystallization
   C. Designing
   D. Economics

10. Powder Processing
    A. Processing & Designing
    B. Metals and Ceramics -
    C. Composites

**Subjected to revision during the first two weeks of the semester
Student Participation

For this course, students will be required to participate in weekly lectures and respond to weekly assignments and solving/answering home work problems/questions. A collection of smaller assignments from each and every chapter will be assigned into complete set of one “Homework/Assignment” for grading purposes. It is the responsibility of the student to track the problems assigned. Also, each of these Homework/Assignment activities will be given point values that add up to the total 100-point participation grade. These points cannot be made up, so students are expected to stay active in the course by completing the assigned problems etc. every week and/or as assigned by the instructor. For more details on the grade points allocated, please see the details below. Also, students are advised to check for updates at the BlackBoard.

Grading and Exams

Your grade for this course will be assessed based on your performance in the quizzes, home work and/or assignments, mid-term exams, and final exam towards the end of course. Quizzes will be given in the class, every week and throughout the semester. There will be at least THREE mid-term exams. There will be one FINAL exam at the end of the semester. The following is the breakup of the grades:

Quizzes, Assignments & Homework (10%)
Mid-Term Exams (45%)
Final Exam (45%)

**Instructor reserves the right to change these proportions any time during the course. However, the changes will be notified to the students. Your FINAL GRADE, following the letter system, will be assigned based on your overall score as per the details below.

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<tr>
<th>GRADE</th>
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<tr>
<td>A</td>
<td>90-100</td>
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<td>B</td>
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<td>C</td>
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<td>D</td>
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Policy on Cheating

Students are expected to be above reproach in all scholastic activities. Students who engage in scholastic dishonesty are subject to disciplinary penalties, including the possibility of failure in the course and dismissal from the university. Scholastic dishonesty includes but is not limited to cheating, plagiarism, collusion, the submission for credit of any work or materials that are attributable in whole or in part to another person, and helping or preparing presentation/term-paper for another person. Scholastic dishonesty harms the individual, all students, and the integrity of the university, policies on scholastic dishonesty will be strictly enforced.

Technology Requirements

Some of the course content is delivered via the Internet through the Blackboard learning management system. Ensure your UTEP e-mail account is working and that you have access to the Web and a stable web browser. Google Chrome and Mozilla Firefox are the best browsers for Blackboard; other browsers may cause complications. When having technical difficulties, update your browser, clear your cache, or try switching to another browser.

You will need to have access to a computer/laptop, scanner, a webcam, and a microphone. You will need to download or update the following software: Microsoft Office, Adobe Acrobat Reader, Windows Media Player, QuickTime, and Java. Check that your computer hardware and software are up-to-date and able to access all parts of the course.

If you do not have a word-processing software, you can download Word and other Microsoft Office programs (including Excel, PowerPoint, Outlook and more) for free via UTEP’s Microsoft Office Portal. Click the following link for more information about Microsoft Office 365 and follow the instructions.

IMPORTANT: If you encounter technical difficulties beyond your scope of troubleshooting, please contact the UTEP Help Desk as they are trained specifically in assisting with technological needs of students. Please do not contact me for this type of assistance. The Help Desk is much better equipped than I am to assist you!

Text Books

ADDITIONAL INFORMATION

I. COVID-19 Precautions

Please stay home if you have been diagnosed with COVID-19 or are experiencing COVID-19 symptoms. If you are feeling unwell, please let me know as soon as possible, so that we can work on appropriate accommodations. If you have tested positive for COVID-19, you are encouraged to report your results to covidaction@utep.edu, so that the Dean of Students Office can provide you with support and help with communication with your professors. The Student Health Center is equipped to provide COVID 19 testing.

The Center for Disease Control and Prevention recommends that people in areas of substantial or high COVID-19 transmission wear face masks when indoors in groups of people. The best way that Miners can take care of Miners is to get the vaccine. If you still need the vaccine, it is widely available in the El Paso area, and will be available at no charge on campus during the first week of classes. For more information about the current rates, testing, and vaccinations, please visit epstrong.org

II. Communication & Correspondence

- **Office Hours:** I/TA will be conducting in-person office hours at the specific hours mentioned. If needed, we will conduct the online office hours; the details will be shared or posted (BlackBoard) under announcements.

- **Email:** UTEP e-mail is the best way to contact me or TA. I/we will make every attempt to respond to your e-mail within 24-48 hours of receipt. When e-mailing me, be sure to email from your
MECH 2331  Instructor: Dr. Ramana  Spring, 2023

UTEP student account and please put the course number in the subject line. In the body of your e-mail, clearly state your question. At the end of your e-mail, be sure to put your first and last name, and your university identification number.

- **Announcements**: Check the Blackboard announcements frequently for any updates, deadlines, or other important messages. I use this platform a lot and throughout the course.

III. **Accommodations & Policy**

The University is committed to providing reasonable accommodations and auxiliary services to students, staff, faculty, job applicants, applicants for admissions, and other beneficiaries of University programs, services and activities with documented disabilities in order to provide them with equal opportunities to participate in programs, services, and activities in compliance with sections 503 and 504 of the Rehabilitation Act of 1973, as amended, and the Americans with Disabilities Act (ADA) of 1990 and the Americans with Disabilities Act Amendments Act (ADAAA) of 2008. Reasonable accommodations will be made unless it is determined that doing so would cause undue hardship on the University. Students requesting an accommodation based on a disability must register with the UTEP Center for Accommodations and Support Services (CASS). Contact the Center for Accommodations and Support Services at 915-747-5148, or email them at cass@utep.edu, or apply for accommodations online via the CASS portal.

**Prepared by:**

*Ramana V. Chintalapalle, Professor, Mechanical Engineering*