Course Overview
The most significant technological achievements have always originated through a “materials breakthrough”. Similarly, many engineering failures have also originated through a “materials failure”. Therefore for any given application, the design and selection of materials in order to meet a set of required properties is pervasive to most disciplines of science and all disciplines of engineering.

For that reason, a thorough working knowledge of engineering materials is of great importance as it not only enables the scientist or engineer to design, develop, create, discover, but also directs to mitigate the risks of failures. Such knowledge is derived by understanding the structure and properties of materials (the core elements of this course), and will begin to lay the framework for understanding Materials Science and Engineering. In this course, you will have the opportunity to discover the fundamentals of the structure/properties relationships for all types of materials, including: metals (and their alloys), ceramics, polymers, and composites thereof.

Instructional Method
This class will run very differently from what you have probably experienced in the past. This is a Guided Inquiry Based Flipped and Blended Classroom with In-Class and 50-84% Online Instruction.

Course Description
Structure and properties of metallic and non-metallic materials; microstructure, mechanical testing, phase diagrams, heat treatment, testing, ceramics, polymers, composites, construction materials, failure analysis, nondestructive evaluation, corrosion and thermal properties of materials.

Required Materials
Prentice Hall, ISBN-10: 0136012604
Website: https://bb9.tamucc.edu/

Other Online and Electronic Resources
The instructor will make additional online e-learning resources (e.g., PowerPoint slides, videos, articles, software, websites) available during the semester through Blackboard. You will be given information about these resources. In addition, invited speakers may address various topics during this class.
**Student Learning Objectives:** As a result of the course, the student will

1. Demonstrate an understanding of the six categories of materials (Metals, Ceramics, Glasses, Polymers, Semiconductors and Composites) available to engineers and their fundamental material properties.

2. Demonstrate an ability to analyze electronic configurations of atoms and the types of primary and secondary atomic bonding present in different materials and predict approximate physical and mechanical behavior of a material based on the type of bonding present (covalent, ionic, metallic, and/or van der Waals).

3. Demonstrate an ability to classify and analyze dimensional packing of atoms for different types of materials, the concept of unit cell, Bravais lattices and crystalline structures (BCC, FCC, and HCP), and calculate Miller Indices, atomic packing factor and basic knowledge on crystallography.

4. Demonstrate an understanding of the several types of crystalline defects (point defects, linear defects, planar defects and noncrystalline solids) commonly present in condensed matter.

5. Demonstrate an understanding of the basic principles of stress and strain, and related mechanical properties of materials, and apply the knowledge to conduct tensile test experiments and analyze the results to evaluate the elastic and plastic deformation, yield strength, tensile strength, strain hardening, hardness, and ductility and fracture properties of materials.

6. Demonstrate an understanding of the basic thermal properties of materials and apply the knowledge to conduct heat treatment experiments and to analyze the results of various thermal properties of materials such as thermal expansion, thermal conductivity, thermal shock and the effect of temperature on ductility and brittleness of materials.

7. Demonstrate an understanding of the fundamentals of phase transformation including lever and phase rules, phase diagram, and the relations between composition, temperature and phase fractions applied to equilibrium phase diagrams for given materials systems, and apply the knowledge to predict the equilibrium microstructure of a material comprised of two constituents.

8. Demonstrate an ability to select, analyze and optimize the choices of structural and electronic materials for different applications based on the constraints of the applications.

**Major Course Requirements**

**Grading Metrics:**

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online Homework and Quizzes</td>
<td>20%</td>
</tr>
<tr>
<td>Lab Exercises</td>
<td>20%</td>
</tr>
<tr>
<td>Exam 1</td>
<td>15%</td>
</tr>
<tr>
<td>Exam 2</td>
<td>15%</td>
</tr>
<tr>
<td>Finals</td>
<td>20%</td>
</tr>
<tr>
<td>Attendance and Participation</td>
<td>10%</td>
</tr>
</tbody>
</table>

**Grading Scale:**

- A = 90% - 100%
- B = 80% - 89%
- C = 70% - 79%
- D = 60% - 69%
- F = 59% and below
Guided Inquiry Based Flipped and Blended Classroom:

What is a Blended Classroom and how does it look and operate different from a regular classroom?

Blended Classrooms are those that utilize online content and tools as integral aspects of instruction. Key benefits include: Differentiated Instruction—Maximize engagement by addressing the needs of every student, Data-driven Decisions—Increase fidelity & responsiveness with frequent, well-informed instructional decisions, Accelerated Learning—Improve both the amount & impact of effective instructional time, Sustainable Programs—Make sound instructional processes easy to manage through effective use of technology.

What is a flipped classroom? And why flip a classroom?

Traditionally when you go to class, your teacher lectures, you take notes, and maybe do some work to reinforce what you learned. Then you are given homework where you read and do more work that reinforces the material. A flipped classroom is a class where you do reading and lecture material at home, and spend class time really reinforcing and learning the information.

Learning from a lecture is not only boring but generally ineffective. As a student you remember very little from lecture, despite spending a lot of class time taking notes. And to top it off what you don’t understand in class, you have to try to learn at home by doing homework on your own, often with no help. Instead let’s spend home time introducing the information, and then class time really understanding it.

What is a guided inquiry based classroom?

Guided inquiry helps students use their own valid conclusions to understand concepts—as opposed to having it simply told to them by lecture. In this classroom student’s work in small groups on specially designed guided inquiry questions. To make sure that students understand the important concepts, they are guided through the information by answering 3 types of specific guided inquiry questions: Exploration questions ask students to find information that is already presented in the text, or that they can answer from common knowledge, Concept Invention questions ask students to use the answers from the exploration questions to figure out a general concept or approach to solving a problem. These are the key questions of every chapter, because this is where the discovery occurs. Application questions help students practice using the concepts.
**How do I prepare for this class (reading and lecture) at home?**
I will assign the reading topics before the class meeting in Blackboard. You will read the textbook readings at home before coming to the class. Similarly, I will also post the online lecture videos in Blackboard before the class meeting, whenever possible. You will do those online video lectures at home before coming to the class. While you watch it you will take notes just like you would normally in class.

**How and when do I do the homework and quizzes?**
The homework will be assigned online in Blackboard and must be completed by the due date. There will be online quizzes on the assigned topics *possibly both before and/or after the class discussions.* Whenever possible you’ll be also be quickly quizzed when you come to class. All of these will be used to determine what you didn’t “get” from the readings, online lectures, and we’ll spend the rest of class time getting to really understand the information, especially what you are confused about.

**What will we do in class?**
Each class we’ll warm up with a quick quiz to check for understanding of the material from the lecture notes. Then we’ll dive into worksheets, guided inquiry group activities and labs. As necessary I will do mini lectures with a group of students or the whole class who need extra explanation.

**State Adopted Proficiencies/TExES competencies (COE)**

**Course Policies**

*This syllabus is a draft in progress*
The instructor reserves the right to modify it’s contents. While the instructor will attempt to notify all students of any changes, it is ultimately the student’s responsibility to keep appraised of those substitutions/changes/additions/deletions/etc.

**Attendance/Tardiness**
Students are expected to attend every scheduled class and laboratory meeting. Routine events should be scheduled to avoid class conflicts. In general, only unavoidable absences are excused with valid proof of documentation (major family illness or accidents, deaths, funerals).

**Participation**
All students are expected to participate actively in class room discussions, guided inquiry question discussions, working well with team members on lab assignments and contributing at the expected level to the group projects. Participation will be evaluated through instructor evaluation and also by peer-evaluation throughout the semester and it is accounted for grading.

**Classroom/professional behavior**
Texas A&M University-Corpus Christi, as an academic community, requires that each individual respect the needs of others to study and learn in a peaceful atmosphere. Under Article III of the Student Code of Conduct, classroom behavior that interferes with either (a) the instructor’s ability to conduct the class or (b) the ability of other students to profit from the instructional program may be considered a breach of the peace and is subject to disciplinary sanction outlined in article VII of the Student Code of Conduct. Students engaging in unacceptable behavior may be instructed to leave the classroom. This prohibition applies to all instructional forums, including classrooms, electronic classrooms, labs, discussion groups, field trips, etc.
Cell Phone/Electronic Device Usage
Usage of cell phones and other electronic devices such as laptops, ipod, ipad etc. are permitted in class only when instructed by the instructor to use it in classroom.

Late work and Make-up Exams
All assignments should be submitted in the class. Late homework after the due class time will not be accepted, except under rare conditions with prior approval from the instructor. Missed Exams – excused only per TAMUCC guidelines. Make-up exams are given only at extremely rare and unavoidable circumstances such as personal injury, health issues, death of an immediate family member and/or a travel with prior approval.

Extra Credit
Extra Credit questions/problems will be given in some of the tests and homeworks.

Academic Integrity/Plagiarism.
University students are expected to conduct themselves in accordance with the highest standards of academic honesty. Academic misconduct for which a student is subject to penalty includes all forms of cheating, such as illicit possession of examinations or examination materials, falsification, forgery, complicity or plagiarism. (Plagiarism is the presentation of the work of another as one’s own work.) In this class, academic misconduct or complicity in an act of academic misconduct on an assignment or test will result in a 0 for the assignment and possibly an F for the class.

Dropping a Class
I hope that you never find it necessary to drop this or any other class. However, events can sometimes occur that make dropping a course necessary or wise. Please consult with me before you decide to drop to be sure it is the best thing to do. Should dropping the course be the best course of action, you must initiate the process to drop the course by going to the Student Services Center and filling out a course drop form. Just stopping attendance and participation WILL NOT automatically result in your being dropped from the class. 4/11 is the last day to drop a class with an automatic grade of “W” this term.

Preferred methods of scholarly citations
Homework/project calculations should be submitted in an organized and neatly presented form. Circle or box the answers to each problem. Appropriate units must be included on all answers. All calculations need to be on an engineer’s pad. Write your name, the course number, the assignment number, and date. Pages are to be numbered and stapled.

Grade Appeals*
A student who believes that he or she has not been held to appropriate academic standards as outlined in the class syllabus, equitable evaluation procedures, or appropriate grading, may appeal the final grade given in the course. The burden of proof is on the student to demonstrate the appropriateness of the appeal. A student with a complaint about a grade is encouraged to first discuss the matter with the instructor. For complete details on the process, including the responsibilities of the parties involved in the process and the number of days allowed for completing the steps in the process, consult Texas A&M University- Corpus Christi University Procedure 13.02.99.C2.01 Student Grade Appeal Procedures (http://www.tamucc.edu/provost/university_rules/index.html), and the College of Science and Engineering Grade Appeals webpage (http://sci.tamucc.edu/students/GradeAppeal.html). For assistance and/or guidance in the grade appeal process, students may contact the chair or director of the appropriate department or school or the College of Science and Engineering Dean’s Office.
Statement of Civility
Texas A&M University-Corpus Christi has a diverse student population that represents the population of the state. Our goal is to provide you with a high quality educational experience that is free from repression. You are responsible for following the rules of the University, city, state and federal government. We expect that you will behave in a manner that is dignified, respectful and courteous to all people, regardless of gender, ethnic/racial origin, religious background, age, sexual orientation or disability. Behaviors that infringe on the rights of another individual will not be tolerated. http://falcon.tamucc.edu/~students/JAffairs/ja_hndbk_academic_info.htm

Disabilities Accommodations*
The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please call or visit Disability Services at (361) 825-5816 in Driftwood 101.

If you are a returning veteran and are experiencing cognitive and/or physical access issues in the classroom or on campus, please contact the Disability Services office for assistance at (361) 825-5816.

*Required by SACS or HB2504

Statement of Academic Continuity
In the event of an unforeseen adverse event, such as a major hurricane and classes could not be held on the campus of Texas A&M University–Corpus Christi; this course would continue through the use of Blackboard and/or email. In addition, the syllabus and class activities may be modified to allow continuation of the course. Ideally, University facilities (i.e., emails, web sites, and Blackboard) will be operational within two days of the closing of the physical campus. However, students need to make certain that the course instructor has a primary and a secondary means of contacting each student.

Schedule* 

<table>
<thead>
<tr>
<th>No.</th>
<th>Topic</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Materials for Engineering</td>
<td>1/22</td>
</tr>
<tr>
<td>2.</td>
<td>Project - Novel materials</td>
<td>1/22</td>
</tr>
<tr>
<td>3.</td>
<td>Atomic bonding</td>
<td>2/03</td>
</tr>
<tr>
<td>4.</td>
<td>Crystalline Structure</td>
<td>2/10</td>
</tr>
<tr>
<td>5.</td>
<td>Project - Crystalline Structures</td>
<td>2/10</td>
</tr>
<tr>
<td>6.</td>
<td>Crystal Imperfection</td>
<td>2/17</td>
</tr>
<tr>
<td>7.</td>
<td>Project – Impact Test</td>
<td>2/24</td>
</tr>
<tr>
<td>8.</td>
<td>Exam – 1</td>
<td>3/10</td>
</tr>
<tr>
<td>9.</td>
<td>Mechanical Behavior</td>
<td>3/17</td>
</tr>
<tr>
<td>10.</td>
<td>Project – Tensile Test</td>
<td>3/17</td>
</tr>
<tr>
<td>11.</td>
<td>Thermal Behavior</td>
<td>3/31</td>
</tr>
<tr>
<td>12.</td>
<td>Project – Hardness Test</td>
<td>3/31</td>
</tr>
<tr>
<td>13.</td>
<td>Phase Diagrams</td>
<td>4/14</td>
</tr>
<tr>
<td>15.</td>
<td>Exam -2</td>
<td>4/28</td>
</tr>
<tr>
<td>16.</td>
<td>Final Project</td>
<td>5/08</td>
</tr>
</tbody>
</table>

* The schedule given above is only tentative and it may subject to vary.