

## **IENG 301 Materials and Costing SYLLABUS**

**Semester:** Spring 2017, CRN 16050

**Time and location:** Room 205 MRB, 3:30 – 4:20 PM, Thursday

**Number of credit hours:** 1

**Type of course:** Required

**Description:** Utilize a problem based approach to materials selection considering material properties, mechanical properties, design requirements, and economic considerations in the selection of materials and manufacturing processes.

**Prerequisites:** MAE 243 and IENG 377 (MAE 243 can be taken concurrently with IENG 301)

**Textbook :** William D. Callister, Jr., Materials Science and Engineering: An Introduction, 9<sup>th</sup> Edition or earlier, John Wiley & Sons  
Introduction to Manufacturing Processes and Materials, Robert C. Creese, Marcel Dekker, 1999.

**Instructor:** Kenneth Currie, Ph.D., P.E.  
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<https://outlook.office365.com/owa/calendar/b48b2dc8cbd445238512cc71f4fbe92e@mail.wvu.edu/364e0b002cb842d78f59cbd83e7ccc172671935044143053540/S-1-8-1560623927-2898877761-619884869-1685974785/reachcalendar.html>

### **Learning Outcomes:**

Utilize a problem-based approach for considering material properties in the selection of materials for manufacturing processes. By the end of the course, the students will be able to understand and apply:

1. Basics of manufacturing engineering, manufacturing management.
2. Principles and concepts on basic material properties, specifically related to crystal structures, density, and Miller Indices.
3. Principles and concepts on basic material properties, specifically related to general phase diagrams, invariant reactions, Iron-Carbon phase diagram.
4. Principles and concepts on mechanical material property relationships, engineering stress-strain, true stress-strain, and hardness.
5. Principles and concepts on methods for increasing mechanical material properties.
6. Principles and concepts on material codes & coding systems.

**Course Topics:**

Class 1	Introduction
Class 2	Cost Breakeven Analysis
Class 3	Atomic structure & interatomic bonding
Class 4	Dislocations and strengthening mechanisms
Class 5	Exam #1 (February 9 <sup>th</sup> )
Class 6	Mechanical properties of metals
Classes 7 & 8	Cost Tradeoff between Mechanical Properties
Class 9	Phase diagrams
Class 10	Exam #2 (March 23 <sup>rd</sup> )
Class 11 & 12	Phase transformations in metals
Class 13	Metal Classification Codes
Class 14	Heat Treatment
Class 15	Annealing
	Comprehensive Final Exam (Wednesday, May 3 <sup>rd</sup> , 8-10 am)

**Contribution of course to meeting the professional component:**

Engineering topics 100%.

**Course relationship to program educational outcomes:**

1. Mechanical material properties, physical material properties (Outcome 1).
2. Apply strength of materials analysis to understand manufacturing concerns (Outcome 2)

**Grading:**

Quizzes	30%
Test 1	30%
Test 2	30%

*(The lowest of one of the above scores, either Test #1, Test #2, or the Quiz Average, will be dropped resulting in an equivalent contribution to the total grade of 30% each for the remaining two scores summing to 60%)*

Final Exam	40%
<b>Total</b>	<b>100%</b>

**Grading Scale:**

- A = 90 – 100%
- B = 80 – 89%
- C = 70 – 79%
- D = 60 – 69%
- F = 59% or less

**In-Class Quizzes (30%):** In-Class Quizzes will determine 10% of your final average. Quizzes are announced one week in advance and will be given at the beginning of the class period. There are no make-ups allowed for missed quizzes and the lowest two quiz scores in both the lecture and lab will be dropped.

**Tests (60%):** Two tests will be given during the semester. Tests will determine 60% (30% each) of your final average. The tests will begin promptly at 3:30 pm and ends at 4:30 pm. If you arrive late you will not be given extra time to complete the test. Failure to attend a test results in the assignment of a zero for that test grade. Tests are composed of two portions: 10 multiple choice questions (40 points) and 4 exercises (60 points). There are no make-ups allowed for missed tests

**Grade Forgiveness:** Forgiveness of the lowest test grade or quiz average is available. The grade forgiveness can be used for out of town travel (job interview, sports participation, health care visit, etc.) or any emergency situation. Students will have their lowest test grade or quiz average automatically dropped resulting in only 60% of the total grade available from Quizzes and Tests.

**Final Exam (25%):** The final exam is comprehensive of the course material covered during the semester. The exam will determine 25% of your final average. Typically final exams are composed of two portions: 15 multiple choice questions (60 points) and 5 exercises (40 points). There will be no makeup of the final exam. Failure to attend the final exam results in the assignment of a zero for the final grade.

**General Exam Information:**

- Tests and the Comprehensive Final will be closed book although you will be provided an official class cheat sheet that will also be posted in advance on eCampus. You may not bring any other notes, cell phones, or other electronic device such as a smart watch. No headsets or hearing aids will be allowed.
- Students are required to check all pages of a test. Missing a test question is the sole responsibility of the student.
- Students that fail to write their name on the exam will be assigned a zero on the exam.

**Statement on Attendance:** Attendance will not be taken, however, students are responsible for all material covered in class. It is not the instructor's job to provide notes, etc. for students who have not attended lectures. Failure to attend on quiz/test days will result in a grade of zero on that quiz/test.

**Statement on Student Behavior in the Classroom:**

Since you are all professionals in training, you are expected to conduct yourself in a professional manner while in this class. For instance, while the class is in progress, everyone is expected to remove hats and sunglasses, put away the newspaper, **refrain from eating and drinking**, and **turn off cell phones**. Students are expected NOT to talk to other students or laugh or create any such unwanted noise or other disruptions during the class period. Disruptive students will be warned during the class period that such behavior will not be tolerated and will possibly be re-seated. If

disruption continues, the student will be required to leave the class and be referred to the Associate Dean for Academic Affairs for disciplinary action.

**Academic Integrity:**

The integrity of the classes offered by any academic institution solidifies the foundation of its mission and cannot be sacrificed to expediency, ignorance, or blatant fraud. Therefore, I will enforce rigorous standards of academic integrity in all aspects and assignments of this course. For the detailed policy of West Virginia University regarding the definitions of acts considered to fall under academic dishonesty and possible ensuing sanctions, please see the Student Conduct Code at <http://campuslife.wvu.edu/r/download/220286>.

**WVU Inclusivity Statement:**

The West Virginia University community is committed to creating and fostering a positive learning and working environment based on open communication, mutual respect, and inclusion. If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class, please advise me and make appropriate arrangements with the Office of Accessibility Services (293-6700). For more information on West Virginia University's Diversity, Equity, and Inclusion initiatives, please see <http://diversity.wvu.edu>.

**Prepared by:** Ken Currie, IMSE  
January 9, 2017

## Class #1. Introduction

### Civilization and Materials

- \_\_\_\_\_ Age: 10000 to 3000 BC
- \_\_\_\_\_ Age: 4000 BC to 0 BC
- \_\_\_\_\_ Age: 1200 BC to 1900 AD
- \_\_\_\_\_ Age: 1900 to ???

### Structure of Materials

- \_\_\_\_\_ level: electrons within the individual atoms and its interaction with their nuclei
- \_\_\_\_\_ level: the organization of atoms or molecules relative to one another
- \_\_\_\_\_ level: microstructure subject to direct observation using microscopes
- \_\_\_\_\_ level: macrostructure that can be viewed with naked eye

### Property of Materials, Processing, & Performance

- \_\_\_\_\_ : a material trait in terms of the kind and the magnitude of response to a specific imposed **stimulus**. In other words, while in service use, all materials are exposed to external stimuli that evoke some type of response
- \_\_\_\_\_ : how to manufacture or synthesize the materials
- \_\_\_\_\_ : the functionality of the material in a given environment

### Interrelationship among processing, structure, property, and performance



### Family of Materials (Six Types of Materials)

- \_\_\_\_\_ : are normally combination of metallic elements
- \_\_\_\_\_ : compounds between metallic and nonmetallic elements, such as **nitrides, oxides, carbides**
- \_\_\_\_\_ : Many of them are organic compounds that are chemically based on carbon, hydrogen, and other nonmetallic elements; they have very large molecular structures. Examples are plastics, rubber, wood, etc.
- \_\_\_\_\_ : A composite is a material containing two or more integrated materials (constituents or phases), with each material keeping its own identity. They are combination of the best characteristics of each of the component materials.
- \_\_\_\_\_ : have electrical properties that are intermediate between the conductors and insulators, such as Si, Ge, and GaAs, etc.
- \_\_\_\_\_ : replacing diseased or damaged body part as implants