**Course number and name: MTSE 3000: Fundamentals of Materials Science and Engineering I**

**Credits and contact hours:** 3 Credits. Walk in or by appointment

**Instructor’s or course coordinator’s name**: Dr. Marcus L. Young

**Text book, title, author, and year**

Fundamentals of Materials Science and Engineering, An Integrated Approach, by: William D. Callister & David G. Rethwisch, 3rd Edition, John Wiley, 2008, 4th Edition, John Wiley, 2011, or 5th Edition, John Wiley, 2015.

1. *Other supplemental materials*

Electronic copies of lectures on Blackboard.

**Specific Course Information**

1. *Brief description of the content of the course (catalog description)*

Principles of bonding, structure, and structure/property relationships for metals and their alloys, ceramics, polymers and composites. Emphasis on properties and how processes change structure and, consequently, properties.

1. *Prerequisites or co-requisites*

PHYS 1710. CHEM 1410/CHEM 1430 (for MTSE Undergraduates) or CHEM 1415/CHEM 1435.

1. *Indicate whether a required, elective, or selected elective course in the program*

Required

**Specific goals for the course**

1. *Specific outcomes of instruction*

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| **Specific Course Learning Outcome** |  |  |  |  |  |  |  |  |
| 1. Demonstrate ability to relate bond

energy to properties of engineering materials  |  |  |  |  |  |  |  |  |
| 1. Interpret various crystal structures

using Miller Indices for planes and directions  |  |  |  |  |  |  |  |  |
| 1. Determine contributions of

various strengthening mechanisms, including solid solution strengthening, precipitation strengthening, strain hardening, and grain size strengthening (the Hall-Petch relationship)  |  |  |  |  |  |  |  |  |
| 1. Demonstrate ability to read a

phase diagram, including determining phase diagram type, predict phase compositions (given C0 and T), and predict microstructures for given compositions.  |  |  |  |  |  |  |  |  |
| 1. Interpret mechanical properties,

including yield strength, ultimate tensile strength, and elastic modulus from engineering plots of σ-ε |  |  |  |  |  |  |  |  |
| 1. Exhibit awareness of societal implications associated with a material, including globally, economically, and environmentally, as well as occupational safety
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| 1. Conduct and present a material

 selection survey as part of a team for current materials applications.  |  |  |  |  |  |  |  |  |

1. *Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.*

This course addresses ABET Student Outcomes 1,3,4,5 and 7

**Brief list of topics to be covered**

I. Electronic and Atomic Structure and Bonding

 Atomic Structure

 Bonding Types and correlations with properties

II. Material Building Blocks

 Crystalline Structures (Metals and Ceramics)

 Miller Indices

 Single Crystals

 Polycrystalline materials

 Non-crystalline materials

 Polymeric Structures

 Defects

III. On Microstructure-Property Relationships

 Mechanical Properties

 Deformation and Strengthening Mechanisms

IV. On Microstructural Evolution

 Phase Diagrams

 Diffusion

 Phase Transformations

V. Materials in Application

 Failure and Corrosion

 Material Applications and Processing

 Team Presentations on Material Applications

VI. Other Considerations (environment, health, availability, design)

 Electrical, Thermal, Magnetic and Optical Properties

 Characterization