**Course number and name: MTSE 3060: Phase Transformation in Materials**

**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**

Phase Transformations in Metals and Alloys by D. A. Porter, K. E. Easterling, and M.Y. Sherif 3rd edition, CRC Press, 2009.

1. *Other supplemental materials*

None

**Specific Course Information**

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

Principles of structural transformations in materials. Thermodynamics and kinetics of nucleation, growth, precipitation, and martensitic reactions.

1. *Prerequisites or co-requisites*

MTSE 3010/5010 (Bonding and Structure) and MTSE 3030/5000 (Thermodynamics and Phase Diagrams)

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. Students will use their knowledge of thermodynamics to help understand solid-solid and solid-liquid phase transformations
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| 1. Students will use their knowledge of kinetics to help understand solid-solid and solid-liquid phase transformations
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| 1. Students will use their knowledge of nucleation and growth as it applies to solidification
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| 1. Students will select a specific topic related to phase transformations in materials, develop a project on this topic, and present it in class
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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 and 3

**Brief list of topics to be covered**

I. Review of Background Concepts

 Review of Thermodynamics

 Review of Diffusion

II. Solidification, Vitrification, and Crystallization

 Nucleation in Liquids – Homogeneous and Heterogeneous

 Growth of Single Component Systems

 Solidification of Alloys

 Rapidly Solidified Crystalline Products

 Amorphous Metallic Alloys

 Crystallization

 Solid State Amorphization

III. Diffusional Transformations in Solids – Basic Principles

 Nucleation in Solids - Homogeneous and Heterogeneous

 Growth of Solid Precipitates

 Overall Transformation Kinetics – TTT Diagrams

IV. Types of Solid-Solid Diffusional Transformations

 Precipitation Reactions

 Phase Separation

 Cellular Precipitation

 Eutectoid Decomposition

 Massive Transformations

 Ordering Transformations

V. Diffusionless Transformations

 General Features of Martensitic Transformations

 Martensite Crystallography

 Martensite Nucleation

 Martensite Growth

 Examples