**Course number and name: MTSE 4030: Ceramic Science and Engineering**

**Credits and contact hours:** 3 Credits. Tuesdays 9:30-11am

**Instructor’s or course coordinator’s name**: Dr. Rick Reidy

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

Modern Ceramic Engineering: Properties, Processing, and Use in Design, 3rd edition, 2005 D.W. Richerson, CRC Press ISBN: 9781574446937

1. *Other supplemental materials*

None

**Specific Course Information**

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

This course emphasis is on structure-property relationships: chemical bonding, crystal structures, crystal chemistry, electrical properties, thermal behavior, defect chemistry. These principles will be applied to material processing (powder preparation, sol-gel synthesis, densification, toughening mechanisms) and to specific ceramic material systems (engineering ceramics, glasses, dielectrics, superconductors, aerogels).

1. *Prerequisites or co-requisites*

MTSE 3010, MTSE 3020, MTSE 3040.

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. Apply structure property relationships to the design and behavior to ceramic materials |
| 1. Select ceramic materials for appropriate applications |
| 1. Understanding point defects, defect equations, and doping in ceramics as well as how they apply to transport and sintering |
| 1. Use Ellingham and Pourbaix diagrams to predict chemical reactions and synthesize ceramic materials |

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 Outcome 2

**Brief list of topics to be covered**

I Structure and Chemistry

Chemical bonding, crystal structures, crystal chemistry, defect chemistry, phase equilibria, thermodynamics

II Properties

Thermal, mechanical, electrical, dielectric, magnetic, optical properties

III Ceramic Materials

Superconductors, dielectrics, ferroelectrics, glasses, refractories, aerogels/xerogels

IV Processing

Pourbaix diagrams, powder synthesis ((co-)precipitation and sol-gel), densification, sintering, toughening mechanisms, high temperature processing