

## MSE 403: Ceramic Materials

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| <i>Course description:</i>                 | Processing, characteristics, microstructure and properties of ceramic materials.   |
| <i>Number of credits:</i>                  | 3. This course is required.  |
| <i>Course Coordinator:</i>                 | John McCloy  |
| <i>Prerequisites by course:</i>            | MSE 201  |
| <i>Prerequisites by topic:</i>             | <ol style="list-style-type: none"><li>1. Basic knowledge of thermodynamics.</li><li>2. Elementary crystallography and crystal structure.</li><li>3. Mechanical behavior of materials.</li></ol>  |
| <i>Postrequisites:</i>                     | None   |
| <i>Textbooks/other required materials:</i> | None<br>Reference books: <ol style="list-style-type: none"><li>1. Carter, C.B. and Norton, M.G. <i>Ceramic Materials Science and Engineering</i>, Springer.</li><li>2. Barsoum, M. W. <i>Fundamentals of Ceramics</i>, CRC Press.</li></ol>  |
| <i>Course objectives:</i>                  | <ol style="list-style-type: none"><li>1. Review of crystallography and crystal structure.</li><li>2. Review of structure of atoms, molecules and bonding in ceramics.</li><li>3. Discussion on structure of ceramics.</li><li>4. Effects of structure on physical properties.</li><li>5. Ceramic Phase diagrams.</li><li>6. Discussion on defects in ceramics.</li><li>7. Introduction to glass.</li><li>8. Discussion on processing of ceramics.</li><li>9. Introduction to sintering and grain growth.</li><li>10. Introduction to mechanical properties of ceramics.</li><li>11. Introduction to electrical properties of ceramics.</li><li>12. Introduction to bioceramics.</li><li>13. Introduction to magnetic ceramics.</li></ol> |
| <i>Topics covered:</i>                     | <ol style="list-style-type: none"><li>1. Introduction to crystal structure and crystallography.</li><li>2. Fundamentals of structure of atoms.</li><li>3. Structure of ceramics and its influence on properties.</li><li>4. Binary and ternary phase diagrams.</li><li>5. Point defects in ceramics.</li><li>6. Glass and glass-ceramic composites.</li><li>7. Ceramics processing and sintering.</li><li>8. Mechanical properties of ceramics.</li><li>9. Electrical properties of ceramics.</li></ol>  |

- 10. Bio-ceramics.
- 11. Ceramic magnets.

*Expected learning outcomes:*

- 1. Knowledge of crystal structure of ceramics.
- 2. Knowledge of structure-property relationship in ceramics.
- 3. Knowledge of the defects in ceramics (Point defects).
- 4. Knowledge of glass and glass-ceramic composite materials.
- 5. Introductory knowledge on the processing of bulk ceramics.
- 6. Applications of ceramic materials in structural, biological and electrical components.

*Class schedule:*

Three 50-minute lecture sessions per week, for one semester.

*Laboratory schedule:*

None

*Contribution to meeting the professional component:*

Engineering Topics

*Relationship of course to student outcomes:*

3 strongly supported; 2 supported; 1 minimally supported

Student Outcomes Pre-Fall 2018  
(ABET EC2000)

Student Outcomes Fall 2018 forward  
(ABET EC2019)

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*Prepared by:* Andrea Butcherite and Dr. John McCloy

*Date:* May 30, 2018