Course 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).

Course Objectives:

By the end of the course, you should be able to:

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

Course Requirements:

Attendance is expected for each class because your participation in discussions is crucial this course; therefore, students are expected to keep their webcams on during class. If you are unable to make a class, please let me know (text or email) so that I don’t wait for you. 10 or more unexcused absences will lead to a student failing this class. Excused absences include illness, family emergency, religious holiday, and any other unplanned difficulty as determined by the instructor. Five unexcused absences will result in a 5 point deduction from your final course grade. Each additional unexcused absence will result in an additional point deduction in your final course grade (up to 9 absences). While traffic and other issues present difficulties getting to Discovery Park by 8:30am, being more than 15 minutes late for class is disruptive and will be considered “being late.” Consequently, six unexcused late arrivals will result in a 0.5 point deduction from your final course grade. Each additional late arrival will result in an additional 0.5 point deduction in your final course grade.

COVID-19 Impact on Attendance

While attendance is expected as outlined above, it is important for all of us to be mindful of the health and safety of everyone in our community, especially given concerns about COVID-19. Please contact me if you are unable to attend class because you are ill, or unable to attend class due to a related issue regarding COVID-19. It is important that you communicate with me prior to being absent so I may accommodate your needs during your absence.

If you are experiencing any symptoms of COVID-19 (https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html) please seek medical attention from the Student Health and Wellness Center (940-565-2333 or askSHWC@unt.edu) or your health care provider PRIOR to coming to campus. UNT also requires you to contact the UNT COVID Hotline at 844-366-5892 or COVID@unt.edu for guidance on actions to take due to symptoms, pending or positive test results, or potential exposure. While attendance is an important part of succeeding in this class, your health, and those of others in the community, is paramount.

- Required Textbook:
• Exams: There will be two exams and a final worth 90% (30% each) of the total course grade. Exams will be based on the handouts, the text, and class discussions.

• Missed Exams: Difficulties with exam dates must be addressed by the Friday before the assigned date. If an exam is missed, the student must contact the instructor within 12 hours of the start of exam to be permitted an opportunity to make-up the assignment. Make-up exams will cover the same material as the original exam, but may not use the same questions.

• Homework: There will be two homeworks assigned during class and due one or two weeks after assigned. The homeworks are worth 10% of the total grade.

• Grades will be based on:
  two exams (30% each), two homeworks (10%) and a final (30%: oral 7.5%, written 22.5%)

**Grade Distribution**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Letter</th>
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<tbody>
<tr>
<td>90-100</td>
<td>A</td>
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<tr>
<td>80-89</td>
<td>B</td>
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<tr>
<td>70-79</td>
<td>C</td>
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<tr>
<td>60-69</td>
<td>D</td>
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<tr>
<td>&lt; 59</td>
<td>F</td>
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</tbody>
</table>

**Schedule for the Class (subject to change)**

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
<th>Date</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aug 25</td>
<td>introduction, chemical bonding, crystal structures</td>
<td>Oct 15</td>
<td>powder synthesis and processing</td>
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<tr>
<td>Aug 27,</td>
<td>crystal chemistry, defect chemistry</td>
<td>Oct 20</td>
<td>Pourbaix diagrams, Review</td>
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<tr>
<td>Sept 1</td>
<td></td>
<td></td>
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<tr>
<td>Sep 3</td>
<td>phase equilibria, thermodynamics</td>
<td>Oct 22</td>
<td>SECOND EXAM</td>
</tr>
<tr>
<td>Sept 8</td>
<td>physical properties</td>
<td>Oct 27</td>
<td>sol-gel synthesis</td>
</tr>
<tr>
<td>Sept 10</td>
<td>thermal properties</td>
<td>Oct 29</td>
<td>densification</td>
</tr>
<tr>
<td>Sept 15*</td>
<td>mechanical behavior</td>
<td>Nov 3</td>
<td>sintering</td>
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<tr>
<td>Sept 17,22</td>
<td>electrical behavior, polaron,</td>
<td>Nov 5</td>
<td>high temp processing</td>
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<tr>
<td>Sept 24</td>
<td>dielectric behavior, review</td>
<td>Nov 10</td>
<td>toughening mechanisms</td>
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<tr>
<td>Sept 29</td>
<td>FIRST EXAM</td>
<td>Nov 12,17</td>
<td>glasses</td>
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<tr>
<td>Oct 1</td>
<td>magnetic behavior</td>
<td>Nov 19</td>
<td>refractories</td>
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<tr>
<td>Oct 6</td>
<td>optical properties</td>
<td>Nov 24, Dec 1</td>
<td>aerogels/xerogels</td>
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<tr>
<td>Oct 8</td>
<td>Superconductors, dielectrics</td>
<td>Dec 3</td>
<td>review</td>
</tr>
<tr>
<td>Oct 13*</td>
<td>Ferroelectrics</td>
<td>Dec 8, 8-10am</td>
<td>FINAL EXAM (comprehensive)</td>
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</tbody>
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• Although this schedule is quite full, additional topics may be added in response to class interest.

Disabilities Accommodation:
The University of North Texas complies with Section 504 of the 1973 Rehabilitation Act and with the Americans with Disabilities Act of 1990. The University of North Texas provides academic adjustments and auxiliary aids to individuals with disabilities, as defined under the law. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring
accommodation, please see the instructor and/or contact the Office of Disability Accommodation at 940-565-4323 during the first week of class.

**Additional Policies and Procedures:**

**Cell Phones:** Please remember to turn off phones prior to class.

**Extra Help:** Please do not wait for the last minute. If you are having trouble with this class, please come by my office during office hours.

**Academic Integrity:** You are expected to adhere to the UNT Policy on Academic Integrity (Policy 06.003). Violations of which are cheating, fabrication, facilitating academic dishonesty, forgery, plagiarism, and sabotage. Such a violation could range from loss of points on an assignment to failing the class.
ABET Course Syllabus

Course number and name
MTSE 4030: Ceramic Science and Engineering

Credits and contact hours
3 Credits. Tuesdays 8:30-10:50am

Instructor’s or course coordinator’s name
Rick Reidy

Text book, title, author, and year
Modern Ceramic Engineering: Properties, Processing, and Use in Design, 3rd edition, 2005

a. Other supplemental materials
None

Specific Course Information
a. 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).

b. Prerequisites or co-requisites
MTSE 3010, MTSE 3020, MTSE 3040.

c. Indicate whether a required, elective, or selected elective course in the program
Required

Specific goals for the course
a. Specific outcomes of instruction

• Apply structure property relationships to the design and behavior to ceramic materials
• Select ceramic materials for appropriate applications
• Understand point defects, defect equations, and doping in ceramics as well as how they apply to transport and sintering
• Use Ellingham and Pourbaix diagrams to predict chemical reactions and synthesize ceramic materials
b. Student outcomes addressed by the course.

This course addresses ABET Criterion 3 Student Outcome(s): a, c, e.

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