Environmental Degradation of Materials

EMAT 475 – 2011-2012

Instructor: Dr. Sudhakar K.V.
Office Hours: ELC 218, x 4267
M thru F: 1:00–1:50 p.m.
or by appointment

2011-2012 Catalogue Description:
The course topics include Electrochemical mechanisms and principles, Electrode potential, Pourbaix Diagrams, Corrosion rates, Effect of stress and metallurgical factors, Corrosion in soil and atmosphere, Dry corrosion, Corrosion preventive methods involving cathodic and anodic protection, metallic, inorganic, organic coatings, and alloying.

Credits: 3.0 Credit Hours (Lectures)

Designation: Required course (Metallurgical & Materials Engineering, General Engineering – Welding Option)

Prerequisites: CHEM 1066, EMAT 251, EMAT 351 or consent of the instructor.

Lab: There is no lab allotted to this course.

Textbook:

Additional References:
- ASM Handbooks, Corrosion, Vol. 13 & 13A.

Relationship of Course to Metallurgical and Materials Engineering Program Outcomes:
This course deals with the essential aspects of corrosion science and engineering that provide metallurgical/materials engineers/technologists the necessary tools to manage corrosion and prevent corrosion failures.

Objectives: The objective of this course is to provide the student with:
- Fundamental understanding of corrosion, their principles, and applications.
- Various types of corrosion phenomena and their preventive methodologies.
- Knowledge of the limits of these factors in materials/metallurgical engineering.

Outcomes: Graduates of the course will:
- Understand the importance of corrosion and their mechanisms.
- Classify metals as anodes and cathodes based on their electrode potential, galvanic series.
- Understand the principles and applications of pourbaix diagrams.
- Relate corrosion process to the presence of stress, concentration, and composition.
- Analyze dry corrosion and application of Pilling-Bedworth ratio.
- Understand and apply various types of corrosion prevention techniques in engineering.
- Fulfill ABET outcomes a, e and l (consult the Course Catalog and Department Guidelines)
Tentative Course Plan

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<thead>
<tr>
<th></th>
<th>Forecast lectures</th>
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<tbody>
<tr>
<td>1</td>
<td>Corrosion principles and Electrochemical reactions</td>
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<tr>
<td>2</td>
<td>EMF series and Galvanic series</td>
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<td>3</td>
<td>Forms of corrosion</td>
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<td>4</td>
<td>Pourbaix Diagrams</td>
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<td>5</td>
<td>Polarization and corrosion rates</td>
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<td>6</td>
<td>Passivity</td>
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<td>7</td>
<td>Corrosion in soil and microbiological corrosion</td>
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<td>8</td>
<td>Effect of stress</td>
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<td>9</td>
<td>Environmental effects on corrosion</td>
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<td>10</td>
<td>High temperature corrosion</td>
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<td>11</td>
<td>Cathodic and anodic protection</td>
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<td>12</td>
<td>Corrosion prevention-Metallic/ inorganic/organic coatings/alloying</td>
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<td>13</td>
<td>Tests</td>
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<td><strong>Total</strong></td>
<td><strong>42</strong></td>
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Assessment:

- Homework: 15%
- Term Paper: 10%
- Tests (3): 75%
- Total 100%

Excessive absence will result in lowering of the final grade.

Academic Integrity:

Students enrolled in the Metallurgical and Materials Engineering courses are expected to maintain an integrity standard that is consistent with the applicable fundamental canons of the NSPE Code of Ethics for Engineers. Specifically, students are expected to conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.

Academic dishonesty or cheating will not be tolerated. Acts of academic dishonesty include (but are not limited to):
- Plagiarism
- Copying from another student’s paper while taking a quiz or examination
- Using unlawful aids (books, notes, cell phones or other electronic devices, etc.) to pass an examination (unless the instructor has clearly stated that it is an open notes or open book exam)
- Assisting another student in an act of academic dishonesty

If it is determined that a student has deliberately cheated on a quiz, examination, or assignment, he or she will be dropped from the course with an “F” grade. In compliance with Montana Tech policy, cases of academic dishonesty will be reported to the Office of the Vice Chancellor for Academic Affairs.

With one exception, the Department policy is that electronic devices are not to be activated or evident during lectures and examinations. This restriction includes but is not limited to programmable calculators, cell phones, ipods, or entertainment devices. The exception is that students are permitted to use a calculator from the following list during lectures, quizzes, and exams:
Casio – any model fx-115 calculator
Hewlett-Packard – the HP33s and 35s models
Texas Instruments – all TI-30X or TI-36X models

Students that possess unapproved calculators or other electronic devices during a quiz or exam are subject to dismissal from the classroom. Penalties for disregarding the policy during lecture will be enforced at the instructor’s discretion.

**Attendance:**
Students are expected to attend at least 90% of the lectures. **Role may be taken randomly. Students who arrive after role is taken or depart prior to dismissal are considered absent.** Students must arrange to submit assignments, if any, in advance of field trips, athletics, or other school-sanctioned events that force them to miss class. **Students are responsible for notifying the instructor, submitting assignments, if any, and sitting for quiz/examinations prior to the absence.** Following an absence, students must arrange to obtain class notes from another student. The instructor’s lecture notes are not available to students.

**Requirement:**
1. Attend at least 90% of the classes.
2. Attend all tests/exams and all homework assignments MUST be completed.
3. **Talking with other students during lecturing in class is prohibited and is considered disruptive behavior.**

**Contribution to Professional Component:**

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<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Engineering Topics</td>
<td>100%</td>
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<tr>
<td>Engineering Design</td>
<td>Yes (Introductory)</td>
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<tr>
<td>Computer Usage</td>
<td>Yes (limited)</td>
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<tr>
<td>Ethics</td>
<td>No</td>
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<td>Statistics</td>
<td>No</td>
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<td>Safety</td>
<td>No</td>
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**ABET Criteria covered:** a, e, l

**Prepared by:** Dr. Sudhakar K.V.  
**Date:** January 9, 2012