ENTC 4490 Special Topics: Nuclear Power Plant Fundamentals
School of Engineering and Computing Sciences
Fall 2016

A. COURSE INFORMATION

Course number/section: ENTC 4490.W01
Class meeting time: TBA
Class location: Online through NPI

B. INSTRUCTOR INFORMATION

Instructor: Ruby Mehrubeoglu (TAMUCC course administrator)
Office location: EN 222B
Office hours: MW 9:30-11:00, F 10:00-12:00 (for Dr. Mehrubeoglu) and by request
(for the online instructor)
Telephone: 361-825-3378
E-mail: ruby.mehrubeogluATtamucc.edu
Appointments: via phone or e-mail

C. COURSE DESCRIPTION

Catalog Course Description
Understanding the operation of a nuclear electric generation station; includes reactor water
chemistry, material science, electrical science, mechanical science, civil engineering for nuclear
power plant engineers, and digital process control systems. (3 credits)

D. PREREQUISITES AND COREQUISITES

Prerequisites
Prerequisites: Junior or senior classification; approval of the instructor.

Corequisites
N/A
E. **REQUIRED TEXTBOOK(S), READINGS AND SUPPLIES**

**Required Textbook(s) and Reading**
- Nuclear Power Plant Fundamentals lecture notes.
- Other course materials uploaded to WebCT course page

**Supplies**

N/A

F. **STUDENT LEARNING OUTCOMES AND ASSESSMENT**

Assessment is a process used by instructors to help improve learning. Assessment is essential for effective learning because it provides feedback to both students and instructors. A critical step in this process is making clear the course’s student learning outcomes that describe what students are expected to learn to be successful in the course. The student learning outcomes for this course are listed below. By collecting data and sharing it with students on how well they are accomplishing these learning outcomes students can more efficiently and effectively focus their learning efforts. This information can also help instructors identify challenging areas for students and adjust their teaching approach to facilitate learning.

By the end of this course, students should be able to:
1. recognize and recall the basics of nuclear reactor terminology, definitions, and concepts associated with reactor physics and theory and technology of nuclear power plant.
2. learn and apply principles of water chemistry control for nuclear power plant systems.
3. classify different materials and alloys in power plant application and describe effects of radiation on them such as fracture of nuclear fuel, stress development in the reactor vessel wall, erosion/corrosion effects.
4. apply their knowledge of basic electrical theory, basic alternating current (AC) and direct current (DC) theory in application to nuclear power.
5. apply their knowledge of mechanical engineering principals to the theory of valve fundamentals and components, pumps, turbines, vibration, rotating equipment safety.
6. understand and name civil engineering design principles and considerations.
7. understand the construction and principles of operation of the different sensing and indicating devices used at power plants.
Learning Objectives

1) **Introduction to Nuclear Power Plant**
   - Recall the basics nuclear reactor terminology, definitions, and basic concepts associated with reactor physics and theory and technology of nuclear power plant.

2) **Water Chemistry**
   - Classify the chemical properties of materials and the way these properties can impose limitations on the operation of equipment and systems.
   - Explain principles of reactor coolant system chemistry control in PWR and BWR.

3) **Materials**
   - Classify physical and mechanical properties of materials, types of stresses, and mechanisms of fracture and deformation.
   - Outline different alloys and their power plant applications.
   - Identify the stresses induced in the reactor vessel due to heatup and cooldown.
   - Predict different types of mechanical and chemical corrosion, the consequences of their occurrence in a power plant, and methods available to minimize their occurrence.
   - Recall various nondestructive testing methods and their primary applications.

4) **Electrical Science**
   - Differentiate fundamentals of AC and DC theory.
   - Analyze various electrical circuits and describe the characteristics of elements placed in a circuit.

5) **Mechanical Science**
   - Explain how lubrication is used in plant equipment.
   - Define the most important aspects of bolting.
   - Classify the piping systems, valves, pumps and their operating principles.
   - Understand the fundamentals of steam turbines (component parts of a turbine, classification of turbines, basics of turbine operations).
   - Explain the vibration monitoring and hazards associated with rotating equipment. Students will list machinery vibration conditions that are indicators of machine degradation or potential failure.

6) **Civil Engineering**
   - Define basic civil engineering concepts with respect to nuclear power plants.
   - Recall applicable major procedures and an awareness of when and how to seek a civil engineer's assistance.

7) **Digital Process Control Systems** (if time permits)
   - Recall temperature, pressure, level, and flow measuring devices used at most nuclear power plants.
   - Reproduce the measuring techniques, and be able to avoid misreading and other possible diagnose problems with measuring devises.
   - Classify various types of nuclear facility instrumentation and control systems.
   - Interpret the logic diagrams and differentiate analog and digital control systems.

G. **INSTRUCTIONAL METHODS AND ACTIVITIES**

Lectures: The lectures will consist of interactive power point presentations, videos, handouts, and other educational materials. Students are responsible for the material covered in the course materials. The knowledge will be evaluated via homework assignments, short quizzes and take-
home exams.

New course materials will be uploaded to the WebCT course page on a regular basis, each new material upload will be followed up with WebCT notifications sent to the class.

Major events such as HW due and exams will be scheduled in the WebCT calendar.

Students are expected to check the WebCT course page regularly and be up-to-date with the course material, progress and assignments.

Your instructor will be online with all of you at least every two days and will provide feedback within 48 hours on week days. However, if you have an urgent subject that you need to discuss with the instructor you should send an e-mail to the instructor with the course name in the subject line.

For communication and HW submissions please take into account that the Black-board server operates on Central time (USA).

H. MAJOR COURSE REQUIREMENTS AND GRADING

Assessment is based on the following. The final grade is computed as indicated:

<table>
<thead>
<tr>
<th></th>
<th>Percentage</th>
<th>Total Score</th>
<th>Final Course Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework Assignments</td>
<td>20</td>
<td>90 ≤ total</td>
<td>A</td>
</tr>
<tr>
<td>and Short Quizzes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Midterm Exam #1</td>
<td>25</td>
<td>80 ≤ total &lt; 90</td>
<td>B</td>
</tr>
<tr>
<td>Midterm Exam #2</td>
<td>25</td>
<td>70 ≤ total &lt; 80</td>
<td>C</td>
</tr>
<tr>
<td>Final Exam</td>
<td>30</td>
<td>60 ≤ total &lt; 70</td>
<td>D</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100</td>
<td>total &lt; 60</td>
<td>F</td>
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I. **COURSE CONTENT/SCHEDULE**

<table>
<thead>
<tr>
<th>WEEK</th>
<th>LECTURE ID#</th>
<th>LECTURE TOPICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>01 02 03</td>
<td>Review of Syllabus; Introduction to NPP Fundamentals; Nuclear Power Plants; Nuclear Physics Fundamentals</td>
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<tr>
<td></td>
<td>04 05 06</td>
<td>Basic Nuclear and Atomic Physics; Difference between PWR and BWR</td>
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<tr>
<td>2</td>
<td>07 08 09</td>
<td>BWR, ABWR; Fundamentals of Chemistry; Secondary System Water Chemistry Controls; Principles and Purpose of Reactor Coolant System Chemistry Control – PWR</td>
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<tr>
<td>3</td>
<td>10 11 12</td>
<td>BWR – Principles of Coolant System Chemistry Control; Introduction to Material Science; Imperfections in Materials, Fracture and Deformation</td>
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<tr>
<td>4</td>
<td>13 14 15</td>
<td>Effects of Radiation on Materials; Alloys and PP Applications; Nuclear Fuel; Overview; Midterm Exam #1</td>
</tr>
<tr>
<td>5</td>
<td>16 17 18</td>
<td>Basic Electrical Theory; Basic DC Theory; DC Circuits; Batteries</td>
</tr>
<tr>
<td>6</td>
<td>19 20 21</td>
<td>DC Generators; DC Motors; Basic AC Theory; Basic AC Reactive Components; Basic AC Power; AC Generators</td>
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<tr>
<td>7</td>
<td>22 23 24</td>
<td>Voltage Regulators; AC Motors; Transformers; Electrical Distribution Systems; Statistics and Dynamics; Lubrication</td>
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<tr>
<td>8</td>
<td>25 26 27</td>
<td>Bolting; Piping Components</td>
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<tr>
<td>9</td>
<td>28 29 30</td>
<td>Valves; Pumps; Turbines</td>
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<tr>
<td>10</td>
<td>31 32 33</td>
<td>Vibration; Rotating Equipment Safety; Overview of Mechanical Engineering</td>
</tr>
<tr>
<td>11</td>
<td>34 35 36</td>
<td>Midterm Exam #2; Civil Fundamentals; Civil Material &amp; Components; Civil Design Considerations; Temperature Measurement</td>
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<tr>
<td>12</td>
<td>37 38 39</td>
<td>Pressure, Level, Flow Measurements</td>
</tr>
<tr>
<td>13</td>
<td>40 41 42</td>
<td>Control Systems; Logic Diagrams (Digital Control)</td>
</tr>
<tr>
<td>15/16</td>
<td>Overview; Comprehensive Final Exam</td>
<td></td>
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Note: Changes in this course schedule may be necessary and will be announced to the class by the Instructor. The assignments and exams shown are directly related to the Student Learning Outcomes described in Section F.
J. COURSE POLICIES

Attendance/Tardiness

This course will be delivered and evaluated as a distance education course. No on-campus class meetings will be scheduled. Students are expected to complete all assignments. If student misses an assignment or examination the University rules will be followed regarding approved absences. Please submit a completed absence form with supporting material when requesting an excused absence. You must notify the instructor of an absence in a timely fashion.

Late Work and Make-up Exams

HW assignments will be assigned every week. HW assignments will include weekly reading material and exercises. All assignments are due by midnight of the due date.

Absolutely no late homework will be accepted, except for university excused absences. Working together is encouraged. The participating classmates must be listed on the first page. However, the final submitted assignments must be individual work efforts.

If blatant copying is detected for the first time, the score will be 0 for all involved

Late submission (1 week to explain and ask for a new due date):
If a student cannot submit his work by the due date, s/he has 1 week after the due date to explain the reasons for delay and ask for a new due date without GRADE PENALTY. If the student fails to contact the instructor, the delayed work will not be accepted

Absolutely NO late submission of the HWs after 2 weeks of original assigned date will be accepted.

No assignments will be accepted after the last day of classes.

Re-submission of HW sets:
Absolutely NO resubmission for HW assignments is permitted.

Copyright Notice

The handouts used in this course are copyrighted (for questions, contact Dr. Galina Tsetkova at Tsvetkovag@tamu.edu). The term “handouts,” refers to all materials generated for this class, which includes but is not limited to syllabi, quizzes, exams, in-class materials, review sheets, and additional problem sets. Because these materials are copyrighted, you do not have the right to copy the handouts, unless expressly granted permission.

K. COLLEGE AND UNIVERSITY POLICIES

• Academic Integrity (University)
  University students are expected to conduct themselves in accordance with the highest
standards of academic honesty. Academic misconduct for which a student is subject to penalty includes all forms of cheating, such as illicit possession of examinations or examination materials, falsification, forgery, complicity or plagiarism. (Plagiarism is the presentation of the work of another as one’s own work.) In this class, academic misconduct or complicity in an act of academic misconduct on an assignment or test will result in a failing grade.

- **Classroom/Professional Behavior**
  Texas A&M University-Corpus Christi, as an academic community, requires that each individual respect the needs of others to study and learn in a peaceful atmosphere. Under Article III of the Student Code of Conduct, classroom behavior that interferes with either (a) the instructor’s ability to conduct the class or (b) the ability of other students to profit from the instructional program may be considered a breach of the peace and is subject to disciplinary sanction outlined in article VII of the Student Code of Conduct. Students engaging in unacceptable behavior may be instructed to leave the classroom. This prohibition applies to all instructional forums, including classrooms, electronic classrooms, labs, discussion groups, field trips, etc.

- **Statement of Civility**
  Texas A&M University-Corpus Christi has a diverse student population that represents the population of the state. Our goal is to provide you with a high quality educational experience that is free from repression. You are responsible for following the rules of the University, city, state and federal government. We expect that you will behave in a manner that is dignified, respectful and courteous to all people, regardless of sex, ethnic/racial origin, religious background, sexual orientation or disability. Behaviors that infringe on the rights of another individual will not be tolerated.

- **Deadline for Dropping a Course with a Grade of W (University)**
  The grade of W will be assigned to any student officially dropping a course. Please consult with the instructor before you decide to drop to be sure it is the best thing to do. Just stopping attendance and participation WILL NOT automatically result in your being dropped from the class. Should dropping the course be the best course of action, visit the Office of the University Registrar for the Course Drop Form that must submitted. No student is eligible to receive a W without completing the official drop process by this deadline. Please consult the Academic Calendar (http://www.tamucc.edu/academics/calendar/) for the last day to drop a course.

- **Grade Appeals (College of Science and Engineering)**
  As stated in University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures, a student who believes that he or she has not been held to appropriate academic standards as outlined in the class syllabus, equitable evaluation procedures, or appropriate grading, may appeal the final grade given in the course. The burden of proof is upon the student to demonstrate the appropriateness of the appeal. A student with a complaint about a grade is encouraged to first discuss the matter with the instructor. For complete details, including
the responsibilities of the parties involved in the process and the number of days allowed for completing the steps in the process, see University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures. These documents are accessible through the University Rules website at http://www.tamucc.edu/provost/university_rules/index.html, and the College of Science and Engineering Grade Appeals webpage at http://sci.tamucc.edu/students/GradeAppeal.html. For assistance and/or guidance in the grade appeal process, students may contact the chair or director of the appropriate department or school, the Office of the College of Science and Engineering Dean, or the Office of the Provost.

- **Disability Services**
The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. 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 an accommodation, please call or visit Disability Services at (361) 825-5816 in Corpus Christi Hall 116.

If you are a returning veteran and are experiencing cognitive and/or physical access issues in the classroom or on campus, please contact the Disability Services office for assistance at (361) 825-5816.

- **Statement of Academic Continuity**
In the event of an unforeseen adverse event, such as a major hurricane and classes could not be held on the campus of Texas A&M University–Corpus Christi; this course would continue through the use of Blackboard and/or email. In addition, the syllabus and class activities may be modified to allow continuation of the course. Ideally, University facilities (i.e., emails, web sites, and Blackboard) will be operational within two days of the closing of the physical campus. However, students need to make certain that the course instructor has a primary and a secondary means of contacting each student.

L. **OTHER INFORMATION**

- **Academic Advising**
The College of Science & Engineering requires that students meet with an Academic Advisor as soon as they are ready to declare a major. The Academic Advisor will set up a degree plan, which must be signed by the student, a faculty mentor, and the department chair. Meetings are by appointment only; advisors do not take walk-ins. Please call or stop by the Advising Center to check availability and schedule an appointment. The College’s Academic Advising Center is located in Center for Instruction 350 or can be reached at (361) 825-3928.
I reserve the right to modify the information, schedule, assignments, deadlines, and course policies in this syllabus if and when necessary. I will announce such changes in a timely manner during regularly scheduled lecture periods.