ENTC 4490.W01    SPECIAL TOPICS: NUCLEAR POWER PLANT FUNDAMENTALS

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)

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

Student Learning Outcomes

At the end of the course, the students will

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.  

**Required Reading**

• Nuclear Power Plant Fundamentals lecture notes.  
• Other course materials uploaded to WebCT course page  

**Instruction Methods**

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 our Black-board server operates on Central time (USA).

**Major Course Requirements**

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>
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<tbody>
<tr>
<td>Homework Assignments</td>
<td>20</td>
<td>90 ≤ total</td>
<td>A</td>
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<tr>
<td>and Short Quizzes</td>
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<tr>
<td>Midterm Exam #1</td>
<td>25</td>
<td>80 ≤ total &lt; 90</td>
<td>B</td>
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<tr>
<td>Midterm Exam #2</td>
<td>25</td>
<td>70 ≤ total &lt; 80</td>
<td>C</td>
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<tr>
<td>Final Exam</td>
<td>30</td>
<td>60 ≤ total &lt; 70</td>
<td>D</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>100</strong></td>
<td>total &lt; 60</td>
<td><strong>F</strong></td>
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**Course Policies**

**Attendance**

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.

**Assignments**

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.

Academic Integrity/Plagiarism

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, 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 score of 0, and a grade of F in the course.

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 students with a high quality educational experience that is free from repression. Students are responsible for following the rules of the University, city, state and federal government. Students are expected to 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.

Grade Appeals

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 on 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 on the process, including the responsibilities of the parties involved in the process and the number of days allowed for completing the steps in the process, consult Texas A&M University-Corpus Christi University Procedure 13.02.99.C2.01 Student Grade Appeal Procedures (http://www.tamucc.edu/provost/university_rules/index.html), and the College of Science and Engineering Grade Appeals webpage (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 or the College of Science and Engineering Dean’s Office.

**Dropping a Class**

I hope that you never find it necessary to drop this or any other class. However, events can sometimes occur that make dropping a course necessary or wise. Please consult with me before you decide to drop to be sure it is the best thing to do. Should dropping the course be the best course of action, you must initiate the process to drop the course by going to the Student Services Center and filling out a course drop form. Just stopping attendance and participation WILL NOT automatically result in your being dropped from the class. Friday, 6 November 2015, is the last day to drop a class with an automatic grade of “W” this term.

**Disabilities Accommodations**

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 Driftwood 101.

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.
# TENTATIVE SCHEDULE (subject to change)

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<thead>
<tr>
<th>WEEK</th>
<th>Lecture ID#</th>
<th>Lecture Topics</th>
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</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>2</td>
<td>04, 05, 06</td>
<td>Basic Nuclear and Atomic Physics; Difference between PWR and BWR</td>
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<td>3</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>4</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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<td>5</td>
<td>13, 14, 15</td>
<td>Effects of Radiation on Materials; Alloys and PP Applications; Nuclear Fuel; Overview; Midterm Exam #1</td>
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<tr>
<td>6</td>
<td>16, 17, 18</td>
<td>Basic Electrical Theory; Basic DC Theory; DC Circuits; Batteries</td>
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<td>7</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>8</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>9</td>
<td>25, 26, 27</td>
<td>Bolting; Piping Components</td>
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<tr>
<td>10</td>
<td>28, 29, 30</td>
<td>Valves; Pumps; Turbines</td>
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<tr>
<td>11</td>
<td>31, 32, 33</td>
<td>Vibration; Rotating Equipment Safety; Overview of Mechanical Engineering</td>
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<tr>
<td>12</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>13</td>
<td>37, 38, 39</td>
<td>Pressure, Level, Flow Measurements</td>
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<tr>
<td>14</td>
<td>40, 41, 42</td>
<td>Control Systems; Logic Diagrams (Digital Control)</td>
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<tr>
<td>15</td>
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<td>Overview; Comprehensive Final Exam</td>
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