ENTC 4490 Special Topics: Nuclear Power Plant Systems –
PRESSURIZED WATER REACTORS (PWR)
School of Engineering and Computing Sciences
Fall 2018

A. COURSE INFORMATION
   Course number/section: ENTC 4490.W03
   Class meeting time: TBA
   Class location: Online through NPI

B. INSTRUCTOR INFORMATION
   Instructor: Ruby Mehrubeoglu (TAMUCC course administrator)
   Office location: EN 222
   Office hours: MWF 10:50 am -12:30 pm (for Dr. Mehrubeoglu) and
                by request (for online instructor)
   Telephone: 361-825-3378
   E-mail: ruby.mehrubeoglu@tamucc.edu
   Appointments: via phone or e-mail

C. COURSE DESCRIPTION
   Catalog Course Description
   Principal elements of pressurized water reactor nuclear power systems; overview of reactor
   physics, thermodynamics, and heat transfer; focus on systems with both function and interfaces
   stressed throughout; includes basic reactor physics, reactor heat generation, reactor plant systems,
   support systems, and reactor safety. (3 credit hours).

D. PREREQUISITES AND COREQUISITES

   Prerequisites
   Junior or senior classification; approval of the instructor.

   Corequisites
   N/A

E. REQUIRED TEXTBOOK(S), READINGS AND SUPPLIES

   Textbooks/Lecture Notes
   Westinghouse PWR SYSTEMS electronic notes
Suggested Reference Texts

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.

Student Learning Outcomes
At the end of the course, the students will
- learn and utilize basic nuclear reactor terminology, definitions, and concepts associated with design and operation of a pressurized water reactor (PWR)
- apply basic engineering principles in analyzing the design and operation of various PWR plant systems and components, including the primary system, reactor vessel, reactor core, reactor coolant pumps, steam generators, emergency core cooling system, and auxiliary systems.
- apply their knowledge of basic nuclear theory, thermodynamics, fluid dynamics and heat transfer to understand how energy is produced, converted, and transferred within the power plant
- understand the interfaces of various systems and propose how they may interact under given scenarios
- understand how specific safety systems operate and how they work as part of an integrated defense in depth safety philosophy
- synthesize course concepts and engineering fundamentals in evaluating how the various systems behave during various evolutions such as power operations, startup and refueling.

Learning Objectives
This course is offered to students pursuing non-nuclear majors. The course introduces students to the
- Pressurized Water Reactor (PWR) Core Systems: the systems unique to the PWR for control of the fission process and the associated systems and strategy for reactor safety.
- Power Plant Generation: the balance of plant equipment used in the steam cycle.

This course ensures that students understand engineering principles associated with systems and components used in two types of commercial nuclear power plants.

G. INSTRUCTIONAL METHODS AND ACTIVITIES
This is an online class. Participation online is mandatory. Students must have access to a computer with microphone and speakers. Students are expected to use online content system to access notes, lectures, and other course materials. Homework, Quizzes, and exams will be delivered through an online content management system such as Moodle or Blackboard.

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>Online Participation</td>
<td>10</td>
<td>80 ≤ total &lt; 90</td>
<td>B</td>
</tr>
<tr>
<td>Online Quizzes</td>
<td>10</td>
<td>70 ≤ total &lt; 80</td>
<td>C</td>
</tr>
<tr>
<td>Midterm Exam #1</td>
<td>20</td>
<td>60 ≤ total &lt; 70</td>
<td>D</td>
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<tr>
<td>Midterm Exam #2</td>
<td>20</td>
<td>total &lt; 60</td>
<td>F</td>
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<tr>
<td>Final Exam</td>
<td>20</td>
<td></td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>100</strong></td>
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</tbody>
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## I. COURSE CONTENT/SCHEDULE

### TENTATIVE SCHEDULE (subject to change)

<table>
<thead>
<tr>
<th>WEEK*</th>
<th>Course Module</th>
<th>Lecture Topics</th>
<th>Assignments* Exams*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan 8</td>
<td>Reactor Physics – Introduction to Nuclear Power</td>
<td>Introduction and History of Nuclear Power; Basic Nuclear Terminology; Nuclear Stability; Radioactive Decay</td>
<td>HW 1</td>
</tr>
<tr>
<td>Jan 16</td>
<td></td>
<td>Nuclear Reactions; Neutron Life Cycle; Reactivity, Reactivity Coefficients, Burnup</td>
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<tr>
<td>Jan 21</td>
<td>Reactor Heat Generation</td>
<td>Fission Energy Release and Deposition; Fuel Types; Introduction to Heat Transfer</td>
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<tr>
<td>Jan 28</td>
<td>Thermodynamic Aspects of Nuclear Power</td>
<td>Basics of Fluid Dynamics; Working Cycles</td>
<td>HW 2</td>
</tr>
<tr>
<td>Feb 4</td>
<td>Integrated Thermal Analysis</td>
<td>Midterm Exam #1</td>
<td></td>
</tr>
<tr>
<td>Feb 11</td>
<td>Reactor Coolant System – Primary Systems</td>
<td>Reactor Vessel and Internals; Reactor Coolant Pumps; Steam Generator and Pressurizer</td>
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</tr>
<tr>
<td>Feb 18</td>
<td></td>
<td>Reactor Coolant System; Reactor Coolant Pumps, Steam Generator, and Pressurizer; Residual Heat Removal System and Component Cooling Water System</td>
<td>HW 3</td>
</tr>
<tr>
<td>Feb 25</td>
<td>Reactor Coolant System – Secondary Systems</td>
<td>Chemical Volume and Control System</td>
<td>HW 4</td>
</tr>
<tr>
<td>Mar 4</td>
<td>Other Plant Systems</td>
<td>Main Steam and Turbine; Condensate and Feedwater Systems</td>
<td>Midterm Exam #2</td>
</tr>
<tr>
<td>Mar 11</td>
<td>Reactor Safety and Operations</td>
<td>Reactor Control; Defense in Depth</td>
<td>HW 5</td>
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<tr>
<td>Mar 16</td>
<td>Electrical Distribution</td>
<td>Engineered Safety Features; Emergency Core Cooling</td>
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<tr>
<td>15/16</td>
<td>Integrated Ops</td>
<td>Reactor Containment; Generator; Electrical Distribution</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Steady-State Operations; Plant Start-up; Other Plant Modes</td>
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<tr>
<td></td>
<td></td>
<td>Overview; Comprehensive Final Exam</td>
<td>Final Exam</td>
</tr>
</tbody>
</table>

*Subject to change: Please follow NPI Instructor’s syllabus*
J. **COURSE POLICIES**

**Participation**
The course is delivered online which requires participation in an online forum. Each student is expected to make several posts a week to an online forum setup for the course. The grading rubric for participation is below and is made up of three key elements: 1) Each student is expected to respond in a timely fashion to questions made on the board by the instructor; 2) Students are expected to ask questions on the board directed at the instructor and fellow students; and, 3) Students are expected to interact with other students using the online forum.

**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.

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)**
  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 your academic advisor, the Financial Aid Office, and me, before you decide to
  drop this course. 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. Please consult the Academic
  Calendar (http://www.tamucc.edu/academics/calendar/) for the last day to drop a
  course as well as other deadlines.

  (The grade of W will be assigned to any student officially dropping a course by Friday,
  Friday, April 6, 2018. No student is eligible to receive a W without completing the
  official drop process by this deadline. Visit the Office of the University Registrar for
  the Course Drop Form that must submitted. After April 6, 2018, a student will not be
  allowed 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.
GENERAL DISCLAIMER

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.