NEEP 411 | NUCLEAR REACTOR ENGINEERING
Course Syllabus

LECTURE: 2.30pm-3.45pm Wed & Fr. 3534 Engineering Hall

INSTRUCTOR: Raluca Scarlat, ERB 931
Office Hours: Thursday, 2.30-3.30pm, and by appointment

CONTACTING THE INSTRUCTOR: Please use Piazza, to send me a personal or a public message. I highly discourage emailing me – I am not very responsive by email.

GRADER: Juliana Pacheco Duarte

CLASS WEBSITE: https://piazza.com/uw_madison/fall2015/ne411/home
Go to the website and click "Enroll in Course" (very top right of the screen). The enrollment code is **NE411**.

We'll be conducting all class-related discussion here this term. The quicker you begin asking *and answering* questions on Piazza, the quicker you'll benefit from the collective knowledge of your classmates and instructors. I encourage you to ask questions when you're struggling to understand a concept—you can even do so anonymously.

Homework assignments, reading assignments, handouts and announcements will be posted here.

COURSE GOALS:

- Ability to apply mathematics, science and engineering principles to engineering problems pertaining to the design and analysis of nuclear reactors.
- Ability to critically review engineering analysis performed by others, pertaining to nuclear reactors
- Sufficient familiarity with conventional and advanced nuclear reactor systems to identify, formulate and solve engineering problems pertaining to the design and analysis of nuclear reactors.

STUDENT RESPONSIBILITIES:

1. Do the reading in preparation for lecture.
2. Have at least one study buddy in this class.
3. Check Piazza at least twice a week for course announcements and assignments.
4. Ask many questions *all the time*.

BRIEF LIST OF TOPICS TO BE COVERED:

Phenomenology
Heat generation
Steady state and transient conduction heat transfer
Mechanical, thermal, and irradiation stress in solids
Single phase convection, pressure drop and flow distribution, flow-induced vibration
Two-phase heat transfer and flow fundamentals, critical heat flux, chocked flow
Buoyancy-driven flow
Scaling analysis and design of experiments

Reactor Systems
System characteristics of Gen II, III and III+ PWRs and BWRs
System characteristics and pertinent phenomenology of non-LWR reactors
Design basis accidents: case studies
Severe accident evolution: case studies
Passive and intrinsic reactor safety features: case studies

TEACHING PHILOSOPHY: You are responsible for independently studying the material and coming to class prepared with your own learning objectives and questions. My role as an instructor is that of a consultant in your learning process. The homework assignments are designed to guide you through an iterative learning process. At the end of the course you will be asked to integrate all of your homework into a comprehensive analysis of a reactor design – this analysis will constitute the first chapter of your final project for the class.

For those of you who are undergraduate students, this course will prepare you for the design capstone project (NE 412) in three ways: (1) you will learn the fundamentals of reactor thermal analysis, (2) you begin develop independent learning skills; (3) you will learn the importance of soliciting and providing peer review.

For those of you who are graduate students, the course will provide (1) a survey of thermal-hydraulics phenomenology and nuclear reactor designs, and (2) will further develop your skills as an independent learner.

READING ASSIGNMENT & QUIZZES: Reading assignments are posted on Piazza weekly on Wednesday, before lecture, and they are due the following week BEFORE class. There will be unannounced quizzes on the reading material, before it is discussed in class. Only two of the quizzes will count towards your grade. ***At the end of the course, there will be a prize for the student who has accumulated the highest number of points on quizzes.***

CLASS PARTICIPATION: I encourage you to ask questions during lecture, during office hours, and online on Piazza. I encourage you to ask questions of me and of the other students in the class.

HOMEWORK:

- Assignments are posted weekly on Friday, before lecture, and due one week later at the beginning of class.
- No late homework is accepted, unless deadline extension is requested in advance, no later than 24 hours before the deadline. Once you've received your graded homework, you can correct and complete your answers, and resubmit for a re-grade within one week of when it was returned to you; only the latest grade counts. You can resubmit as many re-grades as you wish until the beginning of the last class on Dec 11th.
- Homework assignments are submitted individually, but I encourage you to consult with your classmates in preparing them; ask them to peer-review your work.

SOFTWARE TOOLS: In working on the homework and the final project, you are welcome to use any software: COMSOL, ANSYS, Mathematica, EES, Matlab, MOOSE, AspenPlus etc. For those of you who will be taking NE 412, I highly recommend that you familiarize yourself very well with at least one thermal-hydraulics modeling tool.

I particularly encourage you to learn COMSOL – there are many very good online tutorials, it has a simple user interface, and it can do a broad range of physics.

MOOSE is also particularly interesting because it's a modern modeling platform written in C and developed by Idaho National Laboratory f\or the modeling of a broad range of physics and scales in nuclear reactors; it has a higher learning curve, but if you plan to work in the nuclear industry or do research in nuclear engineering, it would be a worthwhile tool to learn.

EXAMS: Two midterms. Two un-announced quizzes.

GRADING: Midterms & Quizzes: 40% Homework: 25% Final project: 35%
Grading Policy: **A: >80**; AB: 75-80; B: 70-75; BC: 65-70; C: 60-65; D: 50-60; F: <50.

I do not grade on a curve, and my goal is for everyone to get an A. The assignments and exams are challenging, but you have many opportunities for redoing them. *If you have any questions about the grading policy, please let me know early in the semester.*

REQUIRED TEXT: Todreas & Kazimi, "Nuclear Systems Volume I: Thermal Hydraulic Fundamentals," Second Edition
Handouts provided in the classroom and posted on Piazza class website.

Library course website (includes link to online textbook, and list of course reserves):
https://lcp.library.wisc.edu/viewer/show/43332

ADDITIONAL SUGGESTED TEXTS:

Check the course website weekly for updates this list. I also welcome you to contribute to this list. The library and the online scholarly literature have a wealth of material on each of the topics that we cover in the class. I expect you to be proactive in finding some of your own learning material, and I encourage you to share with the class once you come across a particularly useful reading.

Nuclear Heat Transport – El Wakil (ANS)
Transport Phenomena - Bird, Stewart, and Lightfoot (Wiley)
Principles of Heat Transfer - F. Incropera (McGraw Hill)

RESERVE TEXTS:

All of the above books will be available as course reserves at Wendt library.

The honor system applies for all work and activities related to this class, and academic integrity is expected. Please refer to The Academic Integrity Statement of UW-Madison Division of Student Life. (http://students.wisc.edu/doso/acadintegrity.html)