Standardized Syllabus for ENU-4144

ENU-4144 Nuclear Power Plant Reactor Systems 1

1. Catalog Description (including credit hours)
   Basis for light water reactor (LWR) design, the NRC design criteria for LWRs, study of the major systems, components and performance characteristics of LWRs including fuels, primary and secondary coolant systems, emergency and auxiliary systems.(3 Credits),
2. Pre-requisites – EML-3100, ENU-4605 and ENU-4001 with minimum grades of C
   Co-requisites – None
3. Course Objectives
   Following successful completion of this course, the student will have developed an understanding of the domestic nuclear power industry and its place in the broader worldwide industry to include the following requirements; specifically the student will
   a. Understand the current status of the domestic nuclear power industry and the evolving worldwide nuclear industry;
   b. Understand how the General Design Criteria (GDC) and Quality Assurance Criteria (QAC) affect nuclear power plant design, construction and operation;
   c. Be able to describe the nuclear power plant licensing process and the Nuclear Regulatory Commission (NRC) organizational structure and functions.
   d. Understand and be able to discuss the various codes and standards applicable in the design, construction, licensing and operation of a nuclear power plant.
   e. Understand and be able to describe and compare in detail the reactor core, reactor coolant system, and auxiliary systems including engineered safeguards as well as reactor control, protection and instrumentation systems for typical PWR and BWR nuclear power plants.
   f. Understand and be able to discuss and compare the design limitations as well as relative merits and deficiencies of PWRs and BWRs including comparisons with projected new plants where applicable.
4. Contribution of course to meeting the professional component
   All 3 course credits are associated with technology and basic science about equally. This course contains no significant design component.
5. Relationship of course to program outcomes
   a. ABET Program Educational Objectives/Professional Components
      1. Graduates will have successful careers in Nuclear Engineering and related disciplines.
      2. Graduates will pursue advanced degrees or continuing education.
      4. Graduates will use the knowledge and skills obtained in their undergraduate education to practice high ethical and professional standards in Nuclear Engineering and related disciplines.
   b. ABET Program Outcomes Supported
      1. Outcome a: an ability to apply knowledge of mathematics, science and engineering for problem solving in engineering (low level).
      2. Outcome e: an ability to identify, formulate and solve engineering problems (medium level)

3. Outcome f: an understanding of professional, ethical and regulatory responsibility in engineering practice (high level).
4. Outcome g: an ability to communicate effectively, using both oral and written presentations, in engineering practice (medium level).
5. Outcome j: knowledge of contemporary issues as they relate to professional engineering practice (high level).
3. Outcome n: an ability to work professionally in one or more of the areas of nuclear power reactors, nuclear instrumentation and measurement, radiation protection and shielding and radiation sources and applications (high level).

See the following website for the current list of MSE outcomes: http://mse.ufl.edu/students/prospective/undergraduate.html#outcomes

6. Instructor: William G. Vernetson, Ph.D.
   a. Room 237 Nuclear Science Center
   b. Telephone: N/A
   c. vernet@ufl.edu
   d. Class Web site: none
   e. Office Hours
      Tuesdays: 11:45-12:30 p.m.
      Thursdays: 9:30 – 10:00 a.m. and 12:45 – 1-15 p.m.
      Other times by appointment.
7. Teaching Assistant
   a. Office location – N/A
   b. Telephone – N/A
   c. E-mail address – N/A
   d. Office hours – N/A
8. Meeting Times: Tuesday, Period 4 (10:40 a.m.-11:30 p.m.)
   Thursday, Periods 4-5 (10:40 a.m. – 12:35 p.m.)
9. Class/laboratory schedule, i.e., number of sessions each week and duration of each session – no laboratories
10. Meeting Location: Tuesday in 1084 Weimer; Thursday in 2102 McCarty B
11. Material and Supply Fees: N/A
12. Textbooks Required (no specific software requirement) – a set of notes will be made available from Target Copy Center to be supplemented with handouts and emailed references
13. Recommended Reading
   a Nuclear Engineering: Theory and Technology of Commercial Nuclear Power
   Ronald A. Knief
   1992, 2nd edition
   ISBN 1-56032-089-3
   b. Nuclear Power Plant Systems and Equipment
   Kenneth C. Lish
   1972
   ISBN 0-8311-1078-3
   c. Introduction to Nuclear Engineering
   John R. Lamarsh and Anthony J. Baratta

2001, 3rd edition
ISBN 0-201-82498-1

14. Course Outline

A. INTRODUCTION
   1. The Nuclear Industry: Status and Issues
   2. Introduction to Nuclear Power Plants – Light Water Reactors (LWRs)
   3. The Department of Energy
   4. The NRC: Organization and Functions

B. NUCLEAR POWER PLANT REGULATION
   1. Code of Federal Regulations: Title 10 and NRC
      a. 10 CFR 50.34: Content of Applications.
      b. 10 CFR 50.36: Technical Specifications
      c. 10 CFR 50 Appendix A: General Design Criteria
      d. 10 CFR 50 Appendix B: Quality Assurance Criteria
      e. 10 CFR 100: Reactor Siting
   2. Quality Codes and Standards
   3. Safety Analysis Reports (SARs)

C. NUCLEAR POWER PLANT LICENSING
   1. Licensing Procedures and Documentation
   2. Licensing Sequence of Events
   3. Relicensing

D. PWR REACTOR SYSTEMS AND TECHNOLOGY
   1. Reactor Vessel and Internals
   2. Reactor Core and Fuel
   3. Reactor Coolant System (NSSS): Pumps. Pressurizer and Steam Generators
   4. Thermal Hydraulic Design Limitations
   5. Auxiliary Systems (CVCS, BTRS, RHRS, Fuel Handling System, etc.)
   6. Engineered Safeguards
   7. Reactor Control System Instrumentation (NI and NNI)
   8. Reactor Protection System
   9. Nuclear and Non-nuclear Instrumentation Systems

E. BWR REACTOR SYSTEMS AND TECHNOLOGY
   1. Reactor Vessel and Internals
   2. Reactor Core and Fuel
   3. Reactor Coolant System (Recirculation Loop)
   4. Thermal Hydraulic Design Limitations
   5. Auxiliary Systems
   6. Engineered Safeguards
   7. Reactor Control System
   8. Reactor Protection System
   9. Nuclear and Non-nuclear Instrumentation Systems

F. LWR SUPPORT SYSTEMS AND TECHNOLOGY (Selections)
   1. Seismic Design Criteria
   2. Containment Design
   3. Containment and Plant Ventilation Systems
   4. Component Cooling Systems
   5. Spent Fuel Storage Facilities
   6. Radwaste Disposal Systems

15. Attendance is expected but will not be specifically marked off. Missing classes will cause a student's grade to suffer because of missed material and/or quizzes. If a student anticipates missing a class, they should have someone pick up handouts or take notes, and let the instructor know beforehand. Otherwise, a student should see the instructor afterward to get any handout material. Or they may have a classmate pick up any handouts for them.

    All cell phones, iPods, kindles, etc. are to be turned off during class; the only exception is for a note-taking device in which case the instructor must be able to

see it too. Failure to follow this requirement may cause the student to be sent from the classroom. If a student thinks he/she has an emergency situation that potentially requires communications during class, check with the instructor before class for permission. It is expected that all registered students will pay attention which is not to include working puzzles, texting, tweeting, twittering, or whatever.

Students are asked to leave several chairs near the back of the classroom empty as class starts so that late arrivals can use them. Students are allowed to arrive late provided they do not disturb others and it does not occur frequently. Students are especially asked to be considerate of others in the class, especially if they must arrive late at some point. Other than asked not to enter because of frequent tardiness, no penalty is assessed for lateness.

16. Grading – methods of evaluation

    Homework/quizzes - 15%
    Midterm exam 1 -25%
    Midterm Exam 2 - 30%
    Final exam - 30%

17. Grading Scale

A	90-100
B+	85-90-
B	80-85-
C+	75-79+
C	70-75-
D+	65-69+
D	60-65-
F	<60

    Grades are not curved significantly, at most a few per cent though improvement over the course of the semester and classroom effort may be used to clarify close grade boundaries upwards a point or two. Minus grades will be used sparingly. "A C- will not be a qualifying grade for critical tracking courses. In order to graduate, students must have an overall GPA and an upper-division GPA of 2.0 or better (C or better). Note: a C- average is equivalent to a GPA of 1.67, and therefore, it does not satisfy this graduation requirement. For more information on grades and grading policies, please visit:
    https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx

18. Requirements for class attendance and make-up exams, assignments, and other work are consistent with university policies that can be found at:
https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx

19. Honesty Policy – UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic

misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Note that failure to comply with this commitment will result in disciplinary action compliant with the UF Student Honor Code Procedures.
See http://www.dso.ufl.edu/sccr/procedures/honorcode.php

20. Accommodation for Students with Disabilities – Students Requesting classroom accommodation must first register with the Dean of Students Office. That office will provide the student with documentation that he/she must provide to the course instructor when requesting accommodation
21. UF Counseling Services –Resources are available on-campus for students having personal problems or lacking clear career and academic goals. The resources include:
    - UF Counseling & Wellness Center, 3190 Radio Rd, 392-1575, psychological and psychiatric services.
    - Career Resource Center, Reitz Union, 392-1601, career and job search services.
22. Software Use – All faculty, staff and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.