MECHANICAL ENGINEERING PROGRAM

ABET COURSE SYLLABUS

ME 438 Nuclear Power Plant Design. (4 Units) Elective

Course Description: (2019-20 Catalog)	Principal elements of pressurized water reactor nuclear power systems; overview of reactor physics, thermodynamics, and heat transfer; includes basic reactor physics, reactor heat generation, reactor plant systems, support systems, and reactor safety. Field trip may be required. 4 lectures.
Prerequisite Courses:	ME 302 and ME 341.
Prerequisites by Topic:	Thermodynamics I and Fluid Mechanics I.
Textbook: (and/or other required material)	No required textbook
References:	R. A. Knief, *"Nuclear Engineering, Theory and Technology of Commercial Nuclear Power,"* 2nd Edition, American Nuclear Society Inc, 2014. R. L. Murray and K. E. Holbert, "*Nuclear Energy, In Introduction to the Concepts, Systems, and Applications of Nuclear Processes*," 7th Edition, Elsevier, 2015 DOE Fundamentals Handbook, *Nuclear Physics and Reactor Theory*, Volume 1 and 2, DOE-HDBK-1019/1-93, January 1993
Course Coordinator/Instructor:	Jacques Belanger, Assistant Professor of ME

Course Learning Outcomes: The overall course objective is to provide a fundamental understanding of the physics of nuclear energy and how nuclear power plants are designed. This fundamental familiarity will serve as basis for further study, research, and employment for the practicing engineer. For the nuclear physics section, the objectives can be best stated in terms of abilities to analyze certain specific types of applications. For each of the power plant sub-systems, the objectives can be best stated in terms of abilities to design such a system. By subdiscipline, the course goals are:

1. Demonstrate and utilize basic nuclear reactor terminology, definitions, and concepts associated with design and operation of a pressurized water reactor (PWR).
2. 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.

3. Learn to apply knowledge of basic of basic nuclear theory, thermodynamics, fluid dynamics, and heat transfer to understand how energy is produced, converted, and transferred within the power plant.
4. Describe the interfaces of various systems and propose how they may interact under given scenarios.
5. Learn how specific safety systems operate and how they work as part of an integrated defense in depth safety philosophy.
6. Synthesize course concepts and engineering fundamentals in evaluating how various systems behave during various evolution such as power operations, startup, refueling, etc.

Relationship of Course to Mechanical Engineering Student Outcomes:

SO 1: Developed (D)
SO 2:
SO 3: Mastered (M)
SO 4:
SO 5: Mastered (M)
SO 6:
SO 7: Mastered (M)

Topics Covered:

1. Nuclear power plant overview
3. Nuclear physics
4. Nuclear reactor physics
5. Plant thermodynamics cycles
6. Plant material and chemistry
7. Nuclear power plant sub-systems
8. Accident review

Laboratory Projects: No lab but a field trip to Diablo Canyon Power Plant

Class/Lab Schedule: Four 50-minute lectures per week.

Contribution of Course to Meeting the Professional Component:

(a) College-level mathematics and basic sciences:	0 credits
(b) Engineering Topics:	4 credits
Design:	0 credits
(c) General Education:	0 credits
(d) Other:	0 credits

Prepared by: Jacques Belanger

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