United States Naval Academy
Mechanical Engineering Department
ER371 Nuclear Plant Design

Catalog Description: ER371 Nuclear Plant Design **Credit:** 3 (3-0-3)
Fundamentals of nuclear power plant design, with emphasis on basis for light water reactor design. Topics include power reactor economics, design considerations dealing with the nuclear fuel cycle, primary and secondary system components and reactor safety. A term project involving the analysis of a modern nuclear reactor design will be completed.

Prerequisites: ER301 (Fundamentals of Nuclear Engineering)
Corequisites: None

Textbooks: [RAK] - Ronald A. Knief, *Nuclear Engineering: Theory and Technology of Commercial Nuclear Power*, 2nd ed., La Grange Park, IL:ANS, 2008
Supplemental Material:
[JW] - Weisman, J., *Elements of Nuclear Reactor Design*, New York, NY: Elsevier Scientific, 1977

Course Director: CDR Stu Blair

Course Content:

No.	Topic or Subtopic	hrs.
1.	Nuclear Power Plant Design Process	4
2.	Nuclear Fuel - Thermal Performance	7
3	Nuclear Power Plant Structural Design	6
3	Generation II/III Reactor Design Concepts	6
4.	Power Reactor Economics	8
5.	Reactor Safety Systems/Design	3
6.	Probabilistic Risk Assessment	6
7.	Advanced Reactor Plants	5
8.	Naval Reactors Concepts	1
9.	Term Project	6

Assessment Methods:

		YES	NO
A	Quizzes	X	
B	Homework	X	
C	Exams	X	
D	Laboratory Reports		X
E	Oral Presentations		X
F	Design Reports/Notebooks	X	
G	Prototypes/Demonstrations		X
H	Projects	X	
I	Other		X

Course Outcomes[1]:

1. Students will demonstrate an understanding of the basics of the design process applied to nuclear power plant applications and undertake a relevant design project for a nuclear application to include topics such as radioisotope thermoelectric generators, process heat, and reactors for medical isotope production in addition to traditional electric power production. (A,B,C,F,H)
2. Students will demonstrate an understanding of nuclear thermal design considerations including convective and conductive heat transfer models as well as thermal limits for critical heat flux, peak central temperature, and power density. (A,B,C)
3. Students will demonstrate an understanding of contemporary and advanced power reactor designs including PWR, BWR, HTGR, PHWR, PTGR, and LMFBR; their associated coolant, neutron moderator, reactivity control, energy conversion systems, safety, and spent fuel management systems. Increased emphasis will be placed on the AP1000 PWR design. (A,B,C)
4. Students will demonstrate an understanding of engineering economics calculations as applied to nuclear power reactors to include construction costs, fuel costs, and operations and maintenance costs; economic performance metrics such as internal rate of return will be applied. (A,B,C)
5. Students will demonstrate an understanding of the principles of reactor safety system design including design philosophy, current safety systems design, relevant design basis accidents, and probabilistic risk assessment techniques. (A,B,C)
6. Students will demonstrate an understanding of advanced reactor development programs and their relevance to improving nuclear power safety, reliability, and long-term sustainability. (A,B,C)

[1] Letters in parenthesis refer to the assessment methods listed in previous section.

	Course Outcomes					
Program Outcomes	(1)	(2)	(3)	(4)	(5)	(6)
(a)	✓	✓		✓	✓	
(b)						
(c)	✓	✓	✓		✓	✓
(d)	✓	✓				
(e)	✓	✓		✓	✓	
(f)				✓	✓	✓
(g)	✓					
(h)	✓		✓			
(i)	✓					
(j)	✓		✓			✓
(k)	✓	✓		✓	✓	✓

Date of Latest Revision: 20 APR 2017