

NUC K250 Reactor Theory

Required Elective

Catalog Description: This course studies nuclear energy with emphasis on fission, reactor types, moderation of neutrons, activation and decay schemes, transmutations, neutron diffusion theory, and theoretical reactor operation including heat transfer, power transients, instrumentation and resultant radiation.

Prerequisites: MAT K254, NUC K110/111, NUC K117, NUC K118, PHY K114, PHY K115

Textbook(s) or other materials: Basic Nuclear Engineering, Foster and Wright, 4th edition; Nuclear Reactor Engineering, Glasstone and Sesonski, 3rd edition

Course learning outcomes/Expected performance criteria:

The course provides a study of reactor physics; from an introduction to basic concepts, nuclear reactions, fission and fusion mechanisms, radioisotopes and neutron interactions; to the study of reactor criticality with emphasis on neutron diffusion theory, theoretical reactor operation including heat generation and heat transfer, power transients, instrumentation and resultant radiation.

Topics covered:

COURSE TOPICS/CONTENT		HOURS
1.	<u>NUCLEAR REACTIONS</u> Types of Radiation and Interactions Cross Section Flux and Interaction Rate Slowing Down of Neutrons	10
2.	<u>NUCLEAR FISSION AND FUSION</u> Mechanism Products	5
3.	<u>RADIATION DETECTION</u> Ionization in an Electric Field Types of Detectors	5
4.	<u>HEALTH PHYSICS</u> Overview	2
5.	<u>RADIOISOTOPES</u> Overview	2
6.	<u>NEUTRON INTERACTIONS</u> Cross Section Attenuation Mean Free Path Distribution and Flux	8
7.	<u>STEADY-STATE REACTOR</u> Infinite Multiplication Factor Effective Multiplication Factor Neutron Current Density Diffusion Equation Reactor Core Shapes Reflection Reactor Cores Two Group Method Group Method Comparison Fast Reactors Multigroup Techniques	16
8.	<u>TRANSIENT REACTOR BEHAVIOR AND CONTROL</u>	16
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Neutron Lifetime	
Reactivity	
Delayed Neutrons	
Diffusion Equation	
Temperature Effects	
Fission Products	
Poisons	
Fuel Depletion	
Reactor Control	
Doppler Effect	
Reactivity Variances	
9. <u>RADIATION DAMAGE</u>	2
Overview	
10. <u>NUCLEAR HEAT TRANSFER</u>	6
Fuel Elements	
Cooling Channels	
Boiling	
Super Heat	
Liquid Metals	
11. <u>FUEL CYCLE TECHNOLOGY</u>	4
Accident Analysis	
Risk Assessment	
Radioactive Wastes	

TOTAL HOURS 60

Class/Lab schedule: 3 lecture sessions each week

Relationship of course to Criterion 5 and Program Outcomes:

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Date: