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 Kll0/111, NUC K117, NUC K118, PHY Kl14, PHY Kll5

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. NUCLEAR REACTIONS 10

Types of Radiation and Interactions

Cross Section

Flux and Interaction Rate

Slowing Down of Neutrons

1. NUCLEAR FISSION AND FUSION 5

Mechanism

Products

1. RADIATION DETECTION 5

Ionization in an Electric Field

Types of Detectors

1. HEALTH PHYSICS 2

Overview

1. RADIOISOTOPES 2

Overview

1. NEUTRON INTERACTIONS 8

Cross Section

Attenuation

Mean Free Path

Distribution and Flux

1. STEADY-STATE REACTOR 16

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

1. TRANSIENT REACTOR BEHAVIOR AND CONTROL 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

1. RADIATION DAMAGE 2

Overview

1. NUCLEAR HEAT TRANSFER 6

Fuel Elements

Cooling Channels

Boiling

Super Heat

Liquid Metals

1. FUEL CYCLE TECHNOLOGY 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:

All students are required to maintain an online learning portfolio in Digication that uses the college template. Through this electronic tool students will have the opportunity to monitor their own growth in college-wide learning. The student will keep his/her learning portfolio and may continue to use the Digication account after graduation. A Three Rivers General Education Assessment Team will select and review random works to improve the college experience for all. Student work reviewed for assessment purposes will not include names and all student work will remain private and anonymous for college improvement purposes. Students will have the ability to integrate learning from the classroom, college, and life in general, which will provide additional learning opportunities. If desired, students will have the option to create multiple portfolios.

Prepared by: James R. Sherrard Date: Fall 2014

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