MONROE COUNTY COMMUNITY COLLEGE

Course Outcome Summary

Required Program Core Course

NUET 240
Reactor Theory, Design and Safety

Course Information

Division	**Applied Science and Engineering Technology**
Contact Hours	**60**
Theory	**45**
Lab Hours	**15**
Total Credits	**3.0**

Prerequisites: MATL 121, PHY 151, CHEM 151, NUET 100

Course Description

This course presents the fundamental concepts of nuclear reactor theory with a primary focus on light water cooled boiling water reactors. Concepts presented will include neutron interactions, nuclear fission, and chain reactions in thermal light water cooled reactors; thermal diffusion and neutron thermalization; criticality and reactivity calculations; reactivity kinetics and feedback mechanisms; fission product daughter production and radionuclide transmutation; reactor safety principles including emergency core cooling and engineered safety features; design basis accident and core damage mitigation; case studies.

This course is a required core course for students pursuing an AAS in Nuclear Engineering Technology

Program Outcomes Addressed by this Course:

Upon successful completion of this course, students should be able to:

A. Describe and apply the culture of safety, continuous improvement, and peer checking
B. Explain the requirement for documentation, formal procedures, and recordkeeping for nuclear related activities
C. Describe the main systems in a nuclear power plant, and how they are used in power generation
D. Identify typical power plant components and explain their function
E. Describe different sources of radiation, their effects on organic matter, methods of detection, and shielding
F. Identify and define problems in mathematics and scientific terms
G. Recognize assumptions and limits of analysis to the application of technology, including social and ethical implications
H. Recognize the need to engage in lifelong learning, and to perform research or conduct investigations to continuously upgrade knowledge and skills
I. Communicate effectively, and work as part of a team

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Course Outcomes

In order to evidence success in this course, the students will be able to:

1. **Summarize atoms, including components, structure and nomenclature, modes of decay, nuclear interactions, and neutron sources**.
   Applies To Program Outcome

   C. Describe the main systems in a nuclear power plant, and how they are used in power generation
   D. Identify typical power plant components and explain their function
   E. Describe different sources of radiation, their effects on organic matter, methods of detection, and shielding
   F. Identify and define problems in mathematics and scientific terms

2. **Explain basic concepts in reactor physics and perform calculations.**
   Applies To Program Outcome

   C. Describe the main systems in a nuclear power plant, and how they are used in power generation
   D. Identify typical power plant components and explain their function
   E. Describe different sources of radiation, their effects on organic matter, methods of detection, and shielding
   F. Identify and define problems in mathematics and scientific terms

3. **Explain the production process and effects on fission of prompt and delayed neutrons.**
   Applies To Program Outcome

   C. Describe the main systems in a nuclear power plant, and how they are used in power generation
   D. Identify typical power plant components and explain their function
   E. Describe different sources of radiation, their effects on organic matter, methods of detection, and shielding
   F. Identify and define problems in mathematics and scientific terms

4. **Summarize how reactivity varies with the thermodynamic properties of the moderator and the fuel and the use of neutron poisons.**
   Applies To Program Outcome

   C. Describe the main systems in a nuclear power plant, and how they are used in power generation
   D. Identify typical power plant components and explain their function
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5. **Characterize the neutron life cycle, subcritical multiplication, and neutron energy spectrum for various reactor types.**
   Applies To Program Outcome

   C. Describe the main systems in a nuclear power plant, and how they are used in power generation
   D. Identify typical power plant components and explain their function
   E. Describe different sources of radiation, their effects on organic matter, methods of detection, and shielding
   F. Identify and define problems in mathematics and scientific terms

6. **Describe how control rods and fission product poisons affect the reactor core.**
   Applies To Program Outcome

   C. Describe the main systems in a nuclear power plant, and how they are used in power generation
   D. Identify typical power plant components and explain their function
   E. Describe different sources of radiation, their effects on organic matter, methods of detection, and shielding
   F. Identify and define problems in mathematics and scientific terms

7. **Enumerate how power changes in a reactor that is near criticality and perform related calculations.**
   Applies To Program Outcome

   C. Describe the main systems in a nuclear power plant, and how they are used in power generation
   D. Identify typical power plant components and explain their function
   E. Describe different sources of radiation, their effects on organic matter, methods of detection, and shielding
   F. Identify and define problems in mathematics and scientific terms

8. **Explain the concepts concerning reactor startup, operation, and shutdown.**
   Applies To Program Outcome

   A. Describe and apply the culture of safety, continuous improvement, and peer checking
   B. Explain the requirement for documentation, formal procedures, and recordkeeping for nuclear related activities
   C. Describe the main systems in a nuclear power plant, and how they are used in power generation
   D. Identify typical power plant components and explain their function
   H. Recognize the need to engage in lifelong learning, and to perform research or conduct investigations to continuously upgrade knowledge and skills
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9. Summarize basic concepts related to reactor plant protection, accident analysis, and core damage mitigation.

Applies To Program Outcome

A. Describe and apply the culture of safety, continuous improvement, and peer checking
B. Explain the requirement for documentation, formal procedures, and recordkeeping for nuclear related activities
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D. Identify typical power plant components and explain their function
E. Describe different sources of radiation, their effects on organic matter, methods of detection, and shielding
G. Recognize assumptions and limits of analysis to the application of technology, including social and ethical implications
H. Recognize the need to engage in lifelong learning, and to perform research or conduct investigations to continuously upgrade knowledge and skills
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10. Break down in detail major world nuclear industry operating experience, including TMI, Chernobyl, Salem, Brown's Ferry, SL-1 and Davis Besse.

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Date Updated: October 10, 2019
By: MJ Dubois