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
   E. Describe different sources of radiation, their effects on organic matter, methods of detection, and shielding
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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
   I. Communicate effectively, and work as part of a team

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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
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
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

10. Break down in detail major world nuclear industry operating experience, including TMI, Chernobyl, Salem, Brown's Ferry, SL-1 and Davis Besse.

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
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Date Updated: October 10, 2019
By: MJ Dubois

From: Martin Dubois
To: Annette Kiebler; Parmeshwar Coomar
Subject: RE: NUET 240 COS.docx
Date: Monday, November 4, 2019 8:42:26 PM
Attachments: image002.png

Hi Annette,

The Master file is correct and the first draft of the COS was incorrect. My first COS listed NUET 120 when It should have said NUET 100. I hit the wrong key when entering.

The other courses are also prerequisites for NUET 240.

The current catalog is based on the master and is also correct.

I assume this new format will replace the master. All the information is unchanged (or should be).

Marty Dubois

From: Annette Kiebler
Sent: Monday, November 4, 2019 7:13 AM
To: Parmeshwar Coomar <pcoomar@monroeccc.edu>; Martin Dubois <mdubois@monroeccc.edu>
Subject: FW: NUET 240 COS.docx
Importance: High

Good morning, Marty and Peter. The attached revised COS has the same prerequisites as in the master file, not just NUET 100. Please clarify.

Thank you!

Annette Kiebler
Administrative Assistant to the
Vice President of Instruction
Phone: 734-384-4314
Fax: 734-687-6283
email: amkiebler@monroeccc.edu

MCCC HUSKIES

From: Parmeshwar Coomar <pcoomar@monroeccc.edu>
Sent: Friday, November 1, 2019 4:55 PM
To: Annette Kiebler <amkiebler@monroeccc.edu>
Subject: FW: NUET 240 COS.docx

From: Martin Dubois <mdubois@monroeccc.edu>
Sent: Friday, November 1, 2019 4:55 PM
To: Parmeshwar Coomar <pcoomar@monroeccc.edu>
Subject: RE: NUET 240 COS.docx

Prerequisite should be NUET 100. Attached file has been corrected.

Marty Dubois

From: Parmeshwar Coomar
Sent: Tuesday, October 29, 2019 4:26 PM
To: Martin Dubois <mdubois@monroeccc.edu>
Cc: Cameron Albring <calbring@monroeccc.edu>
Subject: FW: NUET 240 COS.docx

Marty, please advise on this one too..

Peter

From: Annette Kiebler <amkiebler@monroeccc.edu>
Sent: Tuesday, October 29, 2019 4:25 PM
To: Parmeshwar Coomar <pcoomar@monroeccc.edu>
Cc: Cameron Albring <calbring@monroeccc.edu>
Subject: NUET 240 COS.docx

Peter –

The prerequisites are different in the master file than on the outline you submitted as well.

The master file shows:

NUET 100 and MATL 121 and PHY 151 and CHEM 151

Which is correct?

Thanks.

Annette