

SOUTHEAST COMMUNITY COLLEGE
CONSTRUCTION, MANUFACTURING AND TECHNOLOGY DIVISION
Energy Generation Operations Technology Program
Revision Date: August 21, 2023
[Syllabus Statements](#)

I. CATALOG DESCRIPTION

Course Number: ENER2102
Course Title: Nuclear Energy
Prerequisite(s): None
Catalog Description: Nuclear energy is a source of power which is created by a nuclear reaction. This course will give the student a basic understanding of the theory and philosophy behind nuclear energy. It will explain the rigors of nuclear culture. The atom and its binding forces will be introduced. Characteristics and properties of the various radiation types will be covered in detail. Nuclear technologies in industry, medicine, and agricultural applications will be discussed.

Credit Hours: 2
Class Hours: 30
Lab Hours: 0
Total Contact Hours: 30

II. COURSE OBJECTIVES: *Course will:*

- A. Familiarize the student with the demanding nature of nuclear culture.
- B. Introduce the student to the atom, its binding forces, and atomic mass and weight.
- C. Familiarize the student with radiation types and characteristics.

III. STUDENT LEARNING OUTCOMES AND GENERAL EDUCATION LEARNING OUTCOMES:

- A. Student Learning Outcomes: *Student will be able to:*
 - 1. Understand the discovery and development of nuclear energy.
 - 2. Explain the theories and philosophies concerning nuclear energy from a scientific point of view.
 - 3. Characterize particles within the atom, including mass, charge, and location within the atom.
 - 4. Describe characteristics of electrostatic and nuclear forces.
 - 5. Discuss attributes of the four types of radiation.
 - 6. Interpret the chart of nuclides.
- B. General Education Learning Outcomes (GELOs)
 - 1. GELO #3: Critical Thinking & Problem Solving
Outcome 1: Collect, identify, interpret and analyze data.

IV. CONTENT/TOPICAL OUTLINE

- A. Introduction to Nuclear Energy
 - 1. History of nuclear energy
 - 2. Nuclear culture
- B. Atomic Models
 - 1. Democritus to Chadwick
 - 2. Modern model
- C. The Atom: Components, Structure, and Identification

1. Characterize the following particles within the atom, including relative mass, charge, and location within the atom:
 - a. Proton
 - b. Neutron
 - c. Electron
 2. DEFINE the terms:
 - a. Atomic Mass Unit (AMU)
 - b. Nucleons
 - c. Nuclide
 - d. Isotope
 3. STATE the two methods by which atoms and subatomic particles are measured.
 4. IDENTIFY elements and isotopes from a Chart of the Nuclides.
 5. Given a standard A_ZX notation for an electrically neutral atom, DETERMINE the following:
 - a. Number of Protons
 - b. Number of Neutrons
 - c. Number of Electrons
- D. Nuclear Forces**
1. DESCRIBE the characteristics of Electrostatic and Nuclear Forces with respect to the following:
 - a. Relative Effective Distance
 - b. Change with Distance
 - c. Nucleons
 2. STATE the purpose of radioactive decay.
 3. IDENTIFY the four basic types of radiation.
 4. DISCUSS the following with respect to the four types of radiation:
 - a. Electrical charge. Relative ability to penetrate substances when compared to the other three types of radiation.
 - b. Size and/or mass.
 - c. Each radiation type's penetration ability of substances when compared to the other types of radiation.
 5. Provided a Chart of the Nuclides, or equivalent information, CALCULATE the following for a given nucleus:
 - a. Binding energy
 - b. Binding energy per nucleon
 6. EXPLAIN the changing slope of the curve associated with a plot of binding energy per nucleon.
- E. Radioactive Decay and Interactions**
1. Given an atom with multiple electron shells, COMPARE the following:
 - a. Allowed number of electrons in the outer shell to the allowed number of the inner shell.
 - b. The energy carried by an electron in an outer shell to the energy carried by an electron in an inner shell.
 2. DESCRIBE outer electron shell response when an ejection of an inner shell electron occurs.
 3. DEFINE the following:
 - a. Ground state energy
 - b. Excited state energy
 - c. Ion
 - d. Ionization

- e. Gamma ray
 - f. X-ray
 - g. Radioactive decay
 - h. Decay chain
 - i. Spontaneous fission
 - j. Half-life
4. EXPLAIN the following with respect to Gamma radiation:
 - a. Photoelectric Effect
 - b. Compton Scattering
 - c. Pair Production
 5. EXPLAIN the environmental interactions of the following forms of radiation, including change in energy:
 - a. Alpha
 - b. Beta
 - c. Gamma (Photoelectric effect, Compton Scattering, and Pair Production)
 6. DESCRIBE the following radioactive decay processes:
 - a. Alpha
 - b. Beta
 - c. Electron Capture
 - d. Photon Decay
 - e. Neutron Emission
 7. EXPLAIN the radioactive decay processes, including the following:
 - a. Differing atomic and mass numbers between the parent and daughter nuclides
 - b. Energy changes associated with the process
 8. CONTRAST the processes of elastic and inelastic scattering.
 9. COMPARE the processes of radioactive capture and fission.
 10. EXPLAIN the relationship between the number of atoms contained in the sample of a radioactive element and the activity of that sample.
 11. DESCRIBE the half-life method of determining radioactive decay.
- F. Nuclear industry careers**
1. Research nuclear career pathways
 2. Discuss preferences to the resume and resume cover letter in the nuclear industry
 3. Discuss the interview process in the nuclear industry
 4. Research and discuss nuclear industry career on-line links and resources

V. INSTRUCTIONAL MATERIALS

- A. Required Text(s): None
- B. Other Resources: Instructor provided, Internet, classroom activities
- C. Outside Reading/Research required: Internet Research assignments
- D. Supplies:
 1. 3 ring binder with blank paper for notes
 2. USB Flash Drive
 3. Scientific calculator

VI. METHODS OF PRESENTATION/INSTRUCTION

- A. Methods of presentation typically include a combination of the following:
 1. Instructor-led learning activities
 2. Assigned research projects
 3. Homework assignments

4. Quizzes and tests

VII. METHODS OF EVALUATION

- A. Methods of evaluation, although determined by the individual instructor, traditionally includes a combination of the following:
 1. Class participation
 2. Regular assignments
 3. Written exams and/or quizzes
 4. Performance and observational assessments

VIII. SPECIFIC COURSE REQUIREMENTS

- A. A minimum grade of “C” or 70% is required to receive credit for this course.
- B. A minimum grade of “B” or 80% is required to achieve the NUCP certificate , in accordance with ACAD 08-006, Revision 1, dated October 2016.
- C. Cheating within the Manufacturing Division: Any violation of academic integrity on assignments, quizzes, or tests will result in a grade of 0 on that assignment, quiz, or test. A second violation in any course after the initial infraction will result in a grade of F for that course. Any additional violations while in the program will result in a suspension from the program.
- D. Credit by Examination: Credit for the course CANNOT be earned through Credit by Examination.