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:	ENER2230
Course Title:	Radiation Detection and Protection
Prerequisite(s):	ENER2102
Catalog Description:	This course presents the theory, application detection and shielding of the various types of radiation. Topics covered include detection devices such as survey meters, core power detectors, personnel monitoring devices, and biological effects of radiation. The course also discusses how exposure to radiation can be minimized and the biological impact of radiation. The "ALARA" philosophy and "NIRL" will be introduced.
Credit Hours:	2
Class Hours:	23
Lab Hours:	23
Total Contact Hours:	46

II. COURSE OBJECTIVES: *Course will:*

A. Explain radiation effects including the effects of radiation on matter and body tissues.
B. Perform calculations that involve radioactive dose and matter.
C. Explain exposure control.
D. Explain the principles and operation of radiation detection and monitors.

III. STUDENT LEARNING OUTCOMES AND GENERAL EDUCATION LEARNING OUTCOMES:

A. Student Learning Outcomes: *Student will be able to:*
- **1.** Explain radiation effects including the effects of radiation on matter and body tissues.
- **2.** Perform calculations that involve radioactive dose.
- **3.** Explain the principles and operation of radiation detection and monitors.
- **4.** Explain exposure control.

B. General Education Learning Outcomes (GELOs)
- **1.** GELO #5: Analytical, Quantitative, and Scientific Reasoning
  Outcomes 2: Understand and create logical arguments supported by quantitative and scientific evidence and communicate those arguments in a variety of formats.

IV. CONTENT/TOPICAL OUTLINE

A. Sources of Radiation
- **1.** Identify and Quantify Natural Background Radiation
  - **a.** Cosmic
  - **b.** Uranium
  - **c.** Thorium
  - **d.** Potassium 40
  - **e.** Radon gas
- **2.** Identify and Quantify Man-Made Radiation
  - **a.** Medical diagnostic x-rays
  - **b.** Radio pharmaceuticals

c. Consumer products
d. Weapons tests
e. Air travel

3. Identify and Quantify Sources of Potential Public Exposure
a. Plant liquid and gaseous effluent releases
b. Transportation of radioactive materials
c. Major accident

4. Contributing Factors to Worker Exposures
a. Piping and components
b. Containment

B. Radioactivity

1. Describe the Process and Characteristics
a. Alpha particles
b. Beta particles
c. Gamma rays
d. Neutron

C. Calculating Radioactive Dose

1. Unit of Measurement
a. Gray (dose)
b. Sievert (dose equivalent)
c. Becquerel (activity)
d. Curie (activity)
e. Roentgen (exposure)
f. Rem (dose equivalent)
g. Rad (dose)

2. Basic Rules of Thumb

3. Conversion of Units

4. Quality Factor and Dose

5. Dose Estimation Calculations

D. Dose Terms

1. Identify and Calculate
a. Deep dose equivalent
b. Eye (lens) dose equivalent
c. Shallow dose equivalent
d. Effective dose equivalent (using weighting factors)
e. Committed dose equivalent (vivo and vitro)
f. Committed effective dose equivalent (vivo and vitro)
g. Total effective dose equivalent
h. Total organ dose equivalent

E. Interactions of Radiation with Matter

1. Directly Ionizing – Charged Particle Interactions
a. Alpha particle interactions
b. Beta particle interactions

2. Indirectly Ionizing – Photon Interactions
a. Gamma interactions
b. X-ray interactions

3. Indirectly Ionizing – Neutron Interactions
a. Neutron interactions
1. Elastic scattering
2. Inelastic scattering
3. Absorption

4. Neutron activation
5. Fission
6. Charged particle emission

F. Biological effects of radiation
1. Radiation Effects on Water
2. Radiation Effects on Cells
3. Radiation Effects in Human Body Tissues
4. Whole Body Effects in Humans

G. Radiation Detectors
1. Area Radiation Monitors
2. Detection Mechanisms
3. Gas Filled Detectors
4. Scintillation Detectors
5. Whole Body Monitors
6. Liquid Radiation Monitors
7. Gaseous Radiation Monitors
8. Solid Radiation Detectors

H. External Personnel Dosimetry
1. The Ideal Dosimeter
2. Personnel Dosimetry and Monitors
3. Photographic Systems
4. Thermoluminescence Systems
5. Optically Stimulated Luminescence Systems
6. Criticality Badges
7. Electronic Personal Dosimetry
8. Special Badge Applications
9. U.S. Regulatory Requirements

I. Environmental Monitoring Programs and Equipment
1. Monitoring Programs
2. Environmental Instruments
3. Environmental Problem Areas

J. Exposure Control
1. Contamination
2. Decontamination
3. Exposure Reduction Methods
   a. Define buildup factor
   b. Time, Distance, and Shielding
   c. Shielding materials
   d. Gamma and neutron shielding calculations
      1. Exponential shielding equation
      2. Half and tenth thickness values
4. Protective Clothing
5. Respirators
6. Exposure Reduction Methods
7. Provisions of 10CFR20
8. Radiologically Controlled Areas
9. Administrative Controls and Limits

K. Nuclear Emergencies
1. Classification of accidents and Incidents
2. Nuclear and Radiological Terrorism Response
3. Review of Past Accidents

L. Radiation Protection Standards and Regulations
- **1.** Standards-Setting Organizations
- **2.** Types of Standards
- **3.** Bases for Protection Standards
- **4.** Dose Limiting Regulations

V. INSTRUCTIONAL MATERIALS

A. Required Text(s): None

B. Supplies:
- **1.** One pair surgical scrubs (top and pant), navy or dark blue only
- **2.** Notebook, pen and pencil
- **3.** Scientific calculator

VI. METHODS OF PRESENTATION/INSTRUCTION

A. Methods of presentation typically include a combination of the following:
- **1.** Online and/or hybrid

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 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. For additional information, refer to the *Academic Integrity* pamphlet available from Student Services.

D. **Credit by Examination:** Credit for the course CANNOT be earned through Credit by Examination.