Syllabus for RPT-2700

INTRODUCTION TO NUCLEAR ENGINEERING TECHNOLOGY AND RADIATION HEALTH PHYSICS

COURSE DESCRIPTION

This course provides a comprehensive introduction to radiation health physics and the role of physics professionals in the field of radiation protection/health. Radiation protection applications in connection with nuclear power generation as well as the nuclear fuel cycle, research, government, industry, medicine, emergency preparedness, and the environment are covered. Students will learn the fundamental tenets of radiation health physics that they can apply when advancing their education and pursuing a potential career in this broad field.

COURSE TOPICS

- Fundamental theories and principles of radiation health physics
- The role of professional health physicists in radiation protection
- Elements of a typical radiation protection program
- Radiation protection standards and regulations for facilities, occupational personnel, the general public, and the environment
- Potential health effects/risks associated with radiation exposure

COURSE OBJECTIVES

After completing this course, you should be able to:

CO1 Describe the profession of radiation protection/health physics and its applications for various settings.

CO2 List the fundamental principles of radiation protection.

CO3 Describe the natural and man-made sources of radioactivity and radiation, as well as the typical types of ionizing radiation.

CO4 Describe and discuss radiation risks and potential health effects.

CO5 Describe and discuss the primary elements of a typical radiation protection program.

CO6 List the typical types of nuclear reactors in use and describe the nuclear fuel cycle.

CO7 Explain the key factors of radiation protection at a nuclear power plant.

CO8 List the key authoritative bodies on radiation protection and regulatory guidance.

CO9 Identify and discuss the key regulations for the use of radiation and radioactive materials.

COURSE MATERIALS

You will need the following materials to complete your coursework. Some course materials may be free, open source, or available from other providers. You can access free or open-source materials by clicking the links provided below or in the module details documents. To purchase course materials, please visit the University's textbook supplier.

Operational Health Physics Training

- Moe, H. J. (1992). *Operational health physics training*. (ANL 88-26 Corrected). Argonne, IL: Argonne National Laboratory.

U.S. Environmental Protection Agency

- Environmental Radiation Protection Requirements for Normal Operations of Activities in the Uranium Fuel Cycle
- 40 CFR 190 Environmental Radiation Protection Requirements for Normal Operations of Activities in the Uranium Fuel Cycle. Volume I
- 40 CFR 190 Environmental Radiation Protection Requirements for Normal Operations of Activities in the Uranium Fuel Cycle. Volume II

U.S. Nuclear Regulatory Commission

- NRC: Consolidated Guidance About Materials: (NUREG-1556)
- NRC Regulations: Title 10, Code of Federal Regulations

COURSE STRUCTURE

Introduction to Nuclear Engineering Technology and Radiation Health Physics is a three-credit, online course consisting of **six** modules. Modules include an overview, topics, learning objectives, study materials, and activities. Module titles are listed below.

- **Module 1: Radiation Health Physics**

Course objectives covered in this module: CO1, CO2, CO5

Topics:
- The origin of radiation health physics
- Radiation health physics and its applications
- Career paths in the profession of health physics
- Typical radiation protection programs
- Radiation protection formal policies, plans, manuals, and procedures
- Safety culture

- **Module 2: Fundamentals of Ionizing Radiation**
  Course objectives covered in this module: CO2, CO3

  Topics:
  - Atomic structure
  - Radioactivity
  - Types of radiation
  - Radioactive decay
  - Chart of the nuclides
  - Interaction with matter
  - Sources of radiation—natural and man-made

- **Module 3: Radiation Standards and Regulations**
  Course objectives covered in this module: CO8, CO9

  Topics:
  - Radiation dose limits
  - Radiological effluents
  - EPA radiological effluents from nuclear facilities
  - Licensing and control of radioactive materials
  - Transportation and packaging of radioactive materials
  - Agreement states
  - Posting and labeling
  - Security of radioactive materials
  - Basic radiation detection and instrumentation
  - Basic statistics for radiation measurements
  - Emergency preparedness and response
  - Record keeping

- **Module 4: Radiation Risk and Health Effects**
  Course objective covered in this module: CO4

  Topics:
  - Biological effects and risk
  - External dosimetry and shielding
  - Internal dosimetry and bioassay
  - Stochastic and non-stochastic effects
  - Dose and dose-response theories

    - Radiation epidemiology

- **Module 5: Nuclear Power Plant Radiation Protection**
  Course objectives covered in this module: CO6, CO7

  Topics:
    - Types of nuclear power plants (NPPs)
    - Research and test reactors—non-power reactors
    - Two primary types of plants: pressurized water reactor (PWR) and boiling water reactor (BWR)
    - Primary sources of radiation in PWR and BWR nuclear power plants
    - Primary radioactive materials including fission products, activation products, noble gases, tritium, and special nuclear material in NPPs
    - Radioactive airborne and liquid effluents
    - Air sampling and analysis
    - Radiation protection programs in NPPs
    - Emergency preparedness
    - Personal protective equipment (PPE)

- **Module 6: Radiation Protection Applications in the Nuclear Fuel Cycle and Nuclear Medicine**
  Course objectives covered in this module: CO5, CO6

  Topics:
    - The nuclear fuel cycle
    - Naturally occurring radioactivity (NORM)
    - Technically enhanced naturally occurring radioactive materials (TENORM)
    - Dry cask storage of spent nuclear fuel
    - Medical occupational radiation protection
    - X-ray machines and radiotherapy devices
    - Nuclear medicine

ASSESSMENT METHODS

For your formal work in the course, you are required to participate in online discussion forums, complete written assignments, and complete a final project. See below for details.

Consult the Course Calendar for due dates.

Promoting Originality

One or more of your course activities may utilize a tool designed to promote original work and evaluate your submissions for plagiarism. More information about this tool is available in this document.

Discussion Forums

In addition to an ungraded Introductions Forum, you are required to participate in **six** graded online class discussions.

Communication with your mentor and among fellow students is a critical component of online learning. Participation in online class discussions involves two distinct activities: an initial response to a discussion question and at least two subsequent comments on classmates' responses.

All of these responses must be substantial. Meaningful participation is relevant to the content, adds value, and advances the discussion. Comments such as "I agree" and "ditto" are not considered value-adding participation. Therefore, when you agree or disagree with a classmate or your mentor, state ***and support*** your position.

You will be evaluated on the quality and quantity of your participation, including your use of relevant course information to support your point of view, and your awareness of and responses to the postings of your classmates. Remember, these are discussions: responses and comments should be properly proofread and edited, mature, and respectful.

Written Assignments

You are required to complete **six** written assignments. The written assignments are on a variety of topics associated with the course modules.

Case Study and PowerPoint Presentation

You will be required to choose a topic and develop a 15-slide presentation on a course-related case study of a nuclear engineering technology or radiation protection activity or event. This case study may be something that already interests you, may be something in the course material that interests you, or may be something that is related to current events in the radiological world, like the Iranian nuclear program or the new types of nuclear reactors that are presently being developed in the United States or are being built in other countries.

Details about your case study and PowerPoint presentation can be found in Modules 2, 3, 4, and 5 and in the Case Study area of the course.

Final Project: Research Paper

You are required to complete a final project in the form of a research paper which will be due at the end of the semester. This paper, which you will put together in four stages, should examine some aspect of radiation protection or nuclear engineering technology that interests you. The focus of this paper might be

a look backward to your experience or forward to a topic that a more in-depth knowledge of will help you to meet your professional goals.

Details about your research paper can be found in the Final Project area of the course and in Modules 2, 3, 4, and 6. Due dates associated with this assignment can be found in the Course Calendar.

GRADING AND EVALUATION

Your grade in the course will be determined as follows:

- **Discussion forums (6)**—40 percent
- **Written assignments (6)**—20 percent
- **Case study and PowerPoint presentation**—20 percent
- **Final project (paper)**—20 percent
    - **Part 1**—1 percent
    - **Part 2**—2 percent
    - **Part 3**—2 percent
    - **Part 4**—15 percent

All activities will receive a numerical grade of 0–100. You will receive a score of 0 for any work not submitted. Your final grade in the course will be a letter grade. Letter grade equivalents for numerical grades are as follows:

A	=	93–100	C+	=	78–79
A–	=	90–92	C	=	73–77
B+	=	88–89	C–	=	70–72
B	=	83–87	D	=	60–69
B–	=	80–82	F	=	Below 60

To receive credit for the course, you must earn a letter grade of C or better (for an area of study course) or D or better (for a course not in your area of study), based on the weighted average of all assigned course work (e.g., assignments, discussion postings, final project).

STRATEGIES FOR SUCCESS

First Steps to Success

To succeed in this course, take the following first steps:

- Read carefully the entire Syllabus, making sure that all aspects of the course are clear to you and that you have all the materials required for the course.

- Take time to read the entire Online Student Handbook. The Handbook answers many questions

about how to proceed through the course and how to get the most from your educational experience at Thomas Edison State University.

- Familiarize yourself with the learning management systems environment—how to navigate it and what the various course areas contain. If you know what to expect as you navigate the course, you can better pace yourself and complete the work on time.

- If you are not familiar with web-based learning be sure to review the processes for posting responses online and submitting assignments before class begins.

Study Tips

Consider the following study tips for success:

- To stay on track throughout the course, begin each week by consulting the Course Calendar. The Course Calendar provides an overview of the course and indicates due dates for submitting assignments and posting discussions.

- Check Announcements regularly for new course information.

Using AI Ethically: A Guide for TESU Students

TESU's Academic Code of Conduct permits student AI use in support of their writing and research process--not as a replacement for original writing. Document AI use with an acknowledgment statement at the end of each assignment, noting the tools and prompts used. Cite any AI-generated content on the References page. Please review Using AI Ethically: A Guide for TESU Students for more detailed information.

COMMITMENT TO DIVERSITY, EQUITY, AND INCLUSION

Thomas Edison State University recognizes, values, and relies upon the diversity of our community. We strive to provide equitable, inclusive learning experiences that embrace our students' backgrounds, identities, experiences, abilities, and expertise.

ACCESSIBILITY AND ACCOMMODATIONS

Thomas Edison State University adheres to the Americans with Disabilities Act (ADA, 1990; ADAAA, 2008) and Section 504 of the Rehabilitation Act of 1973. The Office of Student Accessibility Services (OSAS) oversees requests for academic accommodations related to disabilities; a student who is pregnant, postpartum, or a student parenting a newborn who is not the birth parent [as covered under NJSA18A]; and students requesting academic accommodation for a short-term/temporary illness and/or injury. Information can be found on the Office of Student Accessibility Services webpage and questions can be sent to ADA@tesu.edu.

ACADEMIC POLICIES

To ensure success in all your academic endeavors and coursework at Thomas Edison State University, familiarize yourself with all administrative and academic policies including those related to academic integrity, course late submissions, course extensions, and grading policies.

For more, see:

- University-wide policies
- Undergraduate academic policies
- Undergraduate course policies
- Graduate academic policies
- Graduate course policies
- Nursing student policies
- Nursing graduate student policies
- International student policies
- Academic code of conduct