MECHANICAL ENGINEERING PROGRAM

ABET COURSE SYLLABUS

ME 455: Fundamentals of Nuclear Engineering (3 credits)

Course Description (2008-2010 Catalog):

Fundamentals of nuclear reactor design and analysis of the fission process. Basic health physics, reactor shielding, and nuclear waste management. Calculation of reactor dimensions for criticality. Reactor kinetics and control.

Prerequisite Course: MATH 431, PHYS 182.

Prerequisite by Topic:

- Differential equations
- Introductory and nuclear physics

Textbook: *Introduction to Nuclear Engineering*, J.R. Lamarsh and A.J. Baratta, 3rd Ed., Prentice-Hall

Other Reference Material: N/A

Course Coordinator: Denis Beller, Research Professor

Course Objectives:

(a) Compute number densities and concentrations of various nuclear species.
(b) Analyze radioactive decay rates and compute the subsequent radionuclide concentrations
(c) Explain the processes of nuclear fission and fusion from neutron and energy balances.
(d) Calculate radiation exposure from point and geometrically distributed sources of alpha, beta, gamma, and neutron radiation.
(e) Correlate radiation exposure to expected health consequences
(f) Calculate the amount of shielding necessary to attenuation radiation to acceptable levels.
(g) Describe the operation of various radiation sensors including: TLD's, scintillation detectors, ionization tubes, solid state sensors, and Geiger-Muller devices.
(h) Employ count statistics to correct readings from various types of radiation detectors.
(i) Describe and quantify the effect of various kinds of ionizing radiation on materials.
(j) Solve for the steady-state neutron flux within a reactor.
(k) Calculate transient neutron flux and power levels based on reactor period and reactivity changes.
(l) Describe the differences in design and performance between the following reactor types: PWR, BWR, HTGR, CANDU, LMFBR.
(m) Describe the fuel cycle process include sources of uranium, fuel enrichment and fabrication, fuel burnup, and subsequent waste management.

Relationship of Course to Mechanical Engineering Program Educational Outcomes:

Goal1: Provide mechanical engineering graduates with technical capabilities.					Goal 2: Prepare the mechanical engineering graduates to have effective workplace skills.				Goal 3: Instilling a sense of responsibility as a professional member of society.			
1.a	**1.b**	**1.c**	**1.d**	**1.e**	**2.a**	**2.b**	**2.c**	**2.d**	**3.a**	**3.b**	**3.c**	**3.d**
H	**M**	**L**	**M**	**H**	**L**	**L**	**L**	**H**	**H**	**M**	**M**	**L**

(L)ow (M)edium (H)igh

Topics Covered:

1. Basic atomic and nuclear concepts
2. Radioactivity
3. Charged particle interactions
4. Photon (x and gamma ray) sources and interactions
5. Neutron sources and interactions
6. Radiation detection methods
7. Radiation dose
8. Radiation shielding
9. Sources of natural radiation
10. Fission reactor theory and concepts
11. Nuclear fuel cycle

Laboratory Projects: None

Assessment of Student Progress toward Course Objectives

Two written exams, home-work, and final exam

Class/Laboratory Schedule: T-Th 5:30-6:45 PM (Fall Semester)

Contribution of Course for meeting Professional Component:

(a) Mathematics and basic sciences: 2 credit
(b) Engineering Topics (Design/Science): 1 credit
(c) General Education: 0 credit
(d) Others: 0 credits