

ME416 Nuclear Energy										
L	T	P	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0/1	2/0	4	DEC/GEC		15/25	25	20/25	40/50	-

Objectives: To familiarize the students with basics of nuclear physics, reactor physics and reactor materials. To impart in-depth knowledge of waste management and radiation protection.

Syllabus		Contact Hours
Unit-1	Nuclear Physics: Atomic number and mass numbers, Isotopes, Nuclear energy and nuclear forces, Binding Energy, Nuclear Stability, Radioactivity, Nuclear reactions, Radioactive isotopes, Law of radioactivity, Interaction of radiation (alpha, beta, gamma) with matter, Interaction of neutrons with matter, Absorption radiative capture, Transmutation Fission, Cross section for nuclear reactions. Fission process, Mechanism of nuclear fission, fission cross section, fission products, Basic radio chemistry.	6
Unit-2	Reactor Physics: Neutron balance, Neutron diffusion, Diffusion equation, and its solution, Slowing down of neutrons, Showing down power and moderating ratio. Reactor theory: Multiplication factors, Four factor formula, One group critical equation, Age, Diffusion method, Non-leakage probabilities and effective multiplication factor, Multi group diffusion theory, Homogeneous and heterogeneous reactor systems, Time dependent reactor behaviour.	6
Unit-3	Nuclear Reactor Engineering: Types of reactors, Ordinary water moderated reactors (BWR, PWRO), Heavy water cooled and moderated reactors, Gas cooled reactors (HTGR, AGR), Fast reactors design, Construction and control of nuclear reactors.	8
Unit-4	Heat transfer in nuclear reactors: Heat transfer techniques in nuclear reactors, Design and operation, Thermal stresses, Reactor shielding.	8
Unit-5	Reactor materials: Nuclear fuels, Moderators, Coolants, Reflectors and structural materials. Reprocessing: Nuclear fuel cycle, Spent fuel characteristics, Reprocessing techniques, role of solvent extraction in reprocessing.	8
Unit-6	Waste management and radiation protection: Types of waste, Waste management philosophy and disposal, ICRP recommendations, Radiation hazards and their prevention, Radiation dose units. Status of nuclear technology in India: Indian nuclear power program, Nuclear reactors in India, India's commitment to nuclear nonproliferation.	6
	Total	42

Reference Book:	
1	Nuclear Reactor Engineering, S. Glasstone and A. Seronske, Van Nostrand –Reinhold, ISBN- 0442200579, 1963.
2	Nuclear Chemical Engineering, M. Benedict and T.A. Pigott, McGraw Hill, ISBN-0070045313, 1981.
3	Basic Principles of Nuclear Science and Reactors, L. C. Merritt Wiley Hill, ISBN-0070045313, 1981.
4	Introduction to Nuclear Reactor Physics, S. E. Liverhandt.

Course Outcomes

CO1	An understanding of nuclear energy fundamentals, nuclear fissions, and fission reactors.													
CO2	Able to understand the neutron transport behavior.													
CO3	An understanding of a nuclear steam supply system, nuclear safety, nuclear fuel cycle													
CO4	Learn about radiation protection and ability to perform shielding calculations for a simple reactor system.													
CO5	A general understanding of nuclear power plant systems, licensing, design, operation & maintenance, safety, and security.													
CO6	Ability to perform a general design and nuclear safety analysis for a simple reactor system													

CO-PO/PSO Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	2	2	1	1	1	1	2	2	1	3
CO2	3	3	2	2	2	2	2	1	1	1	1	3	3	2	2
CO3	3	3	3	2	2	2	1	1	1	1	1	2	2	1	3
CO4	3	3	3	3	2	2	2	1	1	1	1	2	3	1	2
CO5	3	3	3	3	3	2	2	1	1	1	1	3	3	2	3
CO6	3	3	3	3	3	2	2	2	1	1	1	2	3	2	3