

AE-419: Nuclear Energy										
L	T	P	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-

**Objectives:** To familiarize the students with the nuclear physics, nuclear energy, principles of nuclear reactors, types of reactors, heat transfer involved in reactors and waste management of radiative material

AE-419: Nuclear Energy		Contact Hours
<b>Unit-1</b>	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	8
<b>Unit-2</b>	Reactor Physics: Neutron balance, Neutron diffusion, Diffusion equation, and its solution, Showing down of neutrons, Showing down power and moderating ratio. Reactor theory: Multiplication factors, Four factor formula, One group critical equation, Age, Diffusion method, 98 Nonleakage probabilities and effective multiplication factor, Multi group diffusion theory, Homogeneous and heterogeneous reactor systems, Time dependent reactor behaviour	6
<b>Unit-3</b>	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	6
<b>Unit-4</b>	Heat transfer in nuclear reactors: Heat transfer techniques in nuclear reactors, Design and operation, Thermal stresses, Reactor shielding	8
<b>Unit-5</b>	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
<b>Unit-6</b>	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	6
<b>Total</b>		<b>42</b>

**Reference Books:**

1	S. Glasstone and A. Seronske, Van Nostrand – Reinhold, “Nuclear Reactor Engineering”, Publisher- Technical Information Center, United States Atomic Energy Commission (ISBN 9780870790096), 1967
2	M. Bendict and T.A. Pigtor, “Nuclear Chemical Engineering”, Publisher- McGraw Hill, 1981 (ISBN: 0070045313)
3	L. C. Merrite Basic Principles of Nuclear Science and Reactors, Publisher-Wiley Hill, 1981
4	S. E. Liverhandt, Introduction to Nuclear Reactor Physics (ISBN -13: 9781124145884)

**Course Outcomes**

CO1	To understand basics of nuclear physics.
CO2	To discuss reactor physics
CO3	To describe various types of reactors and construction and control of nuclear reactors
CO4	To explain heat transfer techniques in nuclear reactors, design and operation, and reactor shielding
CO5	To implement reactor materials and reprocessing techniques role of solvent extraction in reprocessing
CO6	To apply knowledge of waste management and radiation protection nuclear reactors in India.

**CO-PO/PSOMatrix**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2