

Nuclear Reactor Technology - Web course

COURSE OUTLINE

This course aims to introduce to students of final year Mechanical Engineering & Chemical Engineering disciplines, the Indian Nuclear programme, the types of nuclear reactors, principle of heat generation, heat removal & control in thermal reactors, concept of breeding, fast breeder neutronics, core configuration & heat removal in fast breeder reactors.

COURSE DETAIL

Sl.No.	Course content	Duration (in hours)
1	Introduction to reactor system & Three stage Indian nuclear power programme.	2
2	Classification of reactors, characteristics of research, test & power reactors with examples.	1
3	Core configuration & cycle diagrams of thermal reactors (BWR, PWR, PHWR, AGR, HTGR, AHWR) and Fast Reactors.	4
4	Reactors – Characteristics, Selection criteria and comparison of different core and structural materials for reactor internals.	2
5	Thermal Reactors: Basic principles of heat generation, heat sources and distribution, steps involved in heat removal from reactor systems, heat flow and temperature distribution in plate and solid cylindrical fuel elements.	6
6	Primary heat transport system including steam generators, shut down cooling, emergency core cooling system, moderator system.	3
7	Auxiliary systems: Ventilation, annulus gas, process water and fire water systems.	1
8	Secondary systems: Description of flow sheet and major components, Comparison of operating conditions: thermal cycles and major components of thermal and nuclear units.	2



NP-TEL

NPTEL

<http://nptel.iitm.ac.in>

Chemical Engineering

Pre-requisites:

- Knowledge on modes of heat transfer, familiarity with energy balances, differential and integral calculus.

Additional Reading:

- None

Hyperlinks:

- www.barc.gov.in
- www.igcar.gov.in
- www.iaea.org

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9	Typical reactivity balance, Reactor control system – requirements of physics aspects, reactor shut down mechanisms.	2
10	FBR neutronics: Neutron spectrum, reaction cross-section, core characteristics, blanket characteristics, breeding potential, breeding ratio, breeding gain and doubling time.	3
11	Fast Breeder Reactors: Breeding, breeders as inexhaustible energy source.	2
12	Characteristics and types of fast reactors, comparison of some characteristics of fast and thermal reactors, role of fast reactors in Indian nuclear power programme.	2
13	General features of fast reactor core: Introduction, specific power, power density, linear heat rating, burnup, fluence. Operating condition, Requirement and choice of core materials: Fuel, absorber, coolant & structural materials.	3
14	Core engineering: Design constraints - linear rating, maximum temperature of clad, coolant velocity, outlet temperature of coolant, pressure drop in core, core height/diameter ratio, blanket thickness, shielding thickness	3
15	Heat transport system: Introduction to sodium technology – Properties, characteristics and complexities. Heat transport circuit system components.	4
	Total	40

References:

1. "Nuclear Reactor Engineering", Vol. 1 & 2, S. Glasstone, A. Sesonske, Von-Nostrand, 1994.
2. "Fundamentals of Nuclear Science and Engineering", J. Kenneth Shultis, Richard E. Faw, Marcel Dekker, 2002.
3. Nuclear Energy: An Introduction to the Concepts, Systems, and Applications of Nuclear Processes, 5/e, R.L. Murray, Butterworth Heinemann, 2000.
4. "Fast Breeder Reactors", A.E. Walter, A.B. Reynolds, Pergamon Press.
5. "Fast Reactor Technology", J.G. Yevick, M.I.T, Press.