

Course name

Nuclear Reactor Physics – Fall 2015 – 366.2.0105

Lecturer

Dr. Erez Gilad, The Unit of Nuclear Engineering (erez-gilad.me)

Course description

The course covers the fundamentals of neutron life cycle in nuclear reactors. The course includes the basic reactions induced by neutrons, neutron slowing down theory (thermalization), neutron transport equation, neutron diffusion theory, the few-group approximation, reactor kinetics, essentials of nuclear reactor and reactor control. The course emphasizes the physical rational and the mathematical formulation underlying nuclear reactor design, and will be taught in weekly 3 hours sessions.

Prerequisites

The course is intended for engineering or natural sciences graduates. The course requires knowledge of differential and integral calculus and linear algebra. In addition, basic knowledge in Nuclear Engineering is an advantage.

Topics

1. Nuclear reactions, Fission process, Cross sections.
2. Resonances, Neutron scattering, Neutron thermalization.
3. Neutron flux, Moderators, Neutron energy spectrum.
4. Nuclear reactor fundamentals, Neutron life cycle, 4/6 factor formula.
5. Neutron transport equation, Eigenvalues, Flux/Current, Boundary conditions.
6. Neutron kinetics, Delayed neutrons, Point kinetics, Inhour equation.
7. Neutron diffusion approximation, 1-group, 2-group.
8. The bare reactor, Reflected reactor.
9. Point reactor model, Point kinetics equations, Reactor kinetics.
10. Reactivity feedback coefficients, Reactor control, Control rods, Soluble Boron.
11. Burnable poisons, Xe/Sm transients.
12. Burnup and depletion of nuclear fuel.

Textbooks

1. Lamarsh, J.R., *Introduction to Nuclear Reactor Theory*, Addison-Wesley, 1966.
2. Stacey, W.M., *Nuclear Reactor Physics*, New York, Wiley, 2001.
3. Lewis, E.E., *Fundamentals of Nuclear Reactor Physics*, Academic Press, 2008.

Assignments

The course will include individual homework assignments and a final exam.

Grade

Homework	40%
Final exam	60%