

NucE 521 – Neutron Transport Theory

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- Coverage** Derivation of the linearized Boltzmann equation for transport of neutral particles in the forward and adjoint modes. Theoretical aspects and analytical solutions in simplified configurations. Numerical methods for solving the transport equation in general settings. Pertinent issues include: discretization of energy, angle, and spatial variables, solution accuracy, and iterative convergence, among others.
- Textbook** ❖ E. E. Lewis and W. F. Miller, *Computational Methods of Neutron Transport*, American Nuclear Society (1993)
- Reference** ❖ G. I. Bell and S. Glasstone, *Nuclear Reactor Theory*, Van Nostrand Reinhold Co. (1970)
❖ J. J. Duderstadt and L. J. Hamilton, *Nuclear Reactor Analysis*, Wiley (1976)
❖ H. Greenspan, C. N. Kelber, and D. Okrent (eds.), *Computational Methods in Reactor Physics*, Gordon and Breach Science Publishers (1968)
- Prerequisite** NucE 403: Advanced Reactor Design *Or*
Phys 406: Subatomic Physics

Outline

1. The neutron transport equation: Forward & adjoint modes; integral form
2. Theoretical aspects of transport theory
3. Numerical methods for solving the transport equation:
 - a. Stochastic: Monte Carlo
 - b. Deterministic: Diffusion approximation; integral methods; difference methods
4. Energy discretization: Multigroup transport equations
5. Angle discretization: Discrete Ordinates; the P_n & related methods
6. Spatial discretization: Diamond Difference, Characteristic, Nodal, Even-Parity
7. Solution algorithms: Mesh sweep; inner/outer iterations; fission/scattering source
8. Computational issues: Solution accuracy, iterative convergence, multiprocessing
9. Advanced topics: Ray effects; bootstrapping; optimization; sensitivity analysis
10. The basics of Monte Carlo (if time permits)

Grading	Homework Assignments *	30%
	Quizzes	20%
	Midterm	20%
	Final Exam	30%

* Late Homework Policy: Up to **one week** past due date \Rightarrow Grade reduced by 50%
No credit for homework submitted more than one week past the due date