**NucE 521 – Neutron Transport Theory**

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**Topics**

The integral form of the transport equation; the calculation of escape and transmission probabilities; collision probability and interface current (response matrix) methods.

The $P_N$, $DP_N$ and $SP_N$ approximations to the transport equation and the relevant boundary conditions.

The discrete ordinates method in one spatial dimension; the equivalence between $S_N$, $P_{N-1}$ and $DP_{(N-2)/2}$ approximations; special problems of curvilinear geometries.

Diamond-difference approximation, boundary conditions, marching algorithms and acceleration of convergence in discrete ordinates.

Multidimensional discrete ordinates methods, level-symmetric quadrature sets, marching algorithms for Cartesian geometries.

Method Of Characteristics (MOC) - Method of Long Characteristics and Method of Short Characteristics. Applications of MOC in 2-D and 3-D geometries.

**Textbook**
Class notes and handouts

**References**


**Prerequisite**
NucE 403: Advanced Reactor Design

or

Phys 406: Subatomic Physics
Outline

1. The neutron transport equation: forward, adjoint modes; and integral forms.
2. Numerical methods for solving the transport equation:
   a. Stochastic: Monte Carlo
   b. Deterministic: integral and difference methods
3. Time discretization – fixed source and criticality calculations.
4. Energy discretization: multigroup transport equations
5. Angle discretization: Discrete Ordinates and Spherical Harmonics methods.
7. Solution algorithms: inner/outer iterations; and fission/scattering source.
9. Advanced topics: Ray effects; optimization; sensitivity analysis.

Grading

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The computer project will be with CASMO-4, or DRAGON-4.2.