22.54 Neutron Interactions and Applications
(Spring 2002)

Problem Set No. 6 **Due: April 18, 2002**

Problem 1

Write a brief essay on the concept of multiplication constant for a thermal reactor composed of a homogeneous mixture of uranium fuel and water moderator, explaining the four factor formula and non-leakage probabilities. Quote typical values of the four factor and the non-leakage probabilities in your discussion (be sure to cite your reference(s)).

Problem 2

Use MCNP to obtain rough estimates of the four-factor formula for Problem 1 for a specified ratio of fuel to moderator densities (we recommend using a ratio of atomic density of 2% enriched uranium to molecular density of water equal to 2.5). Discuss the values of the various contributions to k_∞ that you obtain in comparison with the results given in Lemarsh, *Introduction to Nuclear Reactor Theory*, p. 305.

Problem 3

Devise a means to use MCNP to calculate the non-leakage probability for a spherical reactor. Compare your results with analytic expressions given by diffusion theory.