

Tfy-56.126 Introduction to Nuclear Engineering (Tf)
Final exam 17 December 2004

1. Give a short explanation of the following terms:
 - a) Buckling
 - b) Fertile fuel
 - c) Reactor period
 - d) Chemical shim
 - e) Fourier's Law
 - f) MOX fuel
2. Present, e.g., as a diagram the neutron cycle of a *finite* thermal reactor from one generation to the next, starting from a situation with n_0 thermal neutrons in the system. The effect of heterogeneity need not be taken into account. At what condition is the reactor critical?
3. The time behavior of an infinite homogeneous reactor is described by the equations

$$t_d \frac{d\Phi(t)}{dt} = [(1 - \beta)k_\infty - 1]\Phi(t) + \frac{\beta}{\Sigma_a} \sum_{i=1}^6 \lambda_i C_i(t)$$

$$\frac{dC_i(t)}{dt} = \beta_i \frac{k_\infty}{\beta} \Sigma_a \Phi(t) - \lambda_i C_i(t).$$

Explain the meaning of the variables and terms and derive the reactivity equation. Describe the asymptotic behavior of the flux solution given by the reactivity equation.

4. Assume a flow channel formed by one PWR fuel rod of length H . The cross-sectional areas of the fuel and the coolant flow are A_f and A_c . The density of the coolant is ρ , its specific heat is c_p , and the coolant flow speed is v . Derive the axial distributions for the coolant temperature T_b and the rod surface temperature T_c . The inlet temperature of the coolant is T_{b0} , the heat transfer coefficient from the rod surface to the coolant is h , and the axial power distribution of the rod is of cosine form. At what axial locations are the maxima of the temperatures T_b and T_c ?
5. Describe the main differences between nuclear power stations with pressurized water reactors and boiling water reactors.