**NPRE 247, Modeling Nuclear Energy System**

**Spring 2013**

Computer Project: Solution of point kinetics equations.

Due date: May 10, 2013

Write a computer program to solve the point kinetics equations (PKE) with one delayed neutron group numerically and time dependent reactivity:

Use a forward difference approximation (explicit scheme) for the numerical solution.

Use  = 0.0065,  = 0.08 /sec,  = 0.0001 sec, C(t = 0) = steady-state, unless otherwise specified. Submit a brief report with your results. See separate instructions on the report content and format.

Part 1, theory

1. Show differential equations you are solving (-5%).
2. Show analytic solution to the differential equation you are solving (-5%).
3. Show outline of derivation of numerical solution (-5%).

Part 2, constant reactivity insertion

Use your program to solve PKE for step reactivity insertion:

n(t = 0) = 1.0

Test your program with different reactivity between 0 = -2$ … 1.1$ and compare with analytic solution, use t small enough to give reliable results (do not show any results).

1. Plot numerical and analytical power at t = 1 sec vs 0, use linear (-5%) and log scale (-5%).
2. Plot numerical and analytical precursor at t = 1 sec vs 0, use linear (-5%) and log scale (-5%).

Part 3, CRE accident

Use your program to solve PKE for Reactivity Insertion Accident (RIA) (e.g. PWR Control Rod Ejection – CRE) with simplified Doppler feedback:

n(t = 0) = 10-6

0 = 1.1$

 = 1.0

1. Plot power (-5%), precursors (-5%) and reactivity (-5%) up to a time of 2 sec.
2. Plot rate of precursor creation (-5%), rate of precursor decay (-5%) and rate of precursor change (-5%).
3. Plot peak power vs 1/t for several different t (-5%).
4. Plot time of peak power vs 1/t for several different t (-5%).

Note: numerical solution with large t might be unstable (oscillations between time-steps). If so, do not report such results. Continue reducing t until you get physically realistic (smooth) solution (-5%).