Final examination FYSN445 - May 14, 2010
(Voit vastata myös suomeksi)

Tehtävä 1.
Answer briefly the following questions:
(a) Derive the expression for the neutron multiplication factor in a thermal reactor.
(b) Explain the role of delayed neutrons in reactor control.
(c) Explain the difference between fissile and fertile isotopes.

Problem 2.
A carbon sample from old vegetation is measured by using AMS technique. In the measurement 2500 counts due to transmitted ^{14}C ions are measured in 10 minutes. A beam of 12 μA is measured when the system is set to transmit $^{12}C^{3+}$ ions. Calculate the atomic ratio of $^{14}C/^{12}C$ in the sample assuming that the transmission of ^{14}C and ^{12}C are the same. What mass of ^{12}C was in the sample if it is totally consumed in half an hour? Assume a constant rate of consumptions during this period and a system efficiency of 1.8%.

Problem 3.
A 2 MeV neutron traveling in water has a head-on collision with an ^{16}O nucleus.
(a) What are the energies of the neutron and nucleus after the collision?
(b) Would you expect the water molecule involved in the collision to remain intact after the event?

Problem 4.
Explain the principle of computed X-ray tomography (CT).

Problem 5.
(a) What is the effective half-life of ^{135}Xe ($T_{1/2\beta^-}$ =9.1 h) in a thermal neutron flux of 10^{14} n/cm^{2}s at a temperature of 800 ^{0}C ? (Help: $\sigma_{a,\,20C} / \sigma_{a,800\,C}$ = 1.1581/0.9887; $\sigma_{a,20C}$ = 2.65 10^6 barn?)
(b) Describe what happens to ^{135}Xe as a function of time after a shutdown of a reactor? What are the consequences if the reactor is turned on to full power again 2, 10 or 100 hours after the shut down?