LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – **PHYSICS**

THIRD SEMESTER – **NOVEMBER 2014**

PH 3955 - REACTOR PHYSICS

Date : 05/11/2014 Dept. No. Max. : 100 Marks

Time : 09:00-12:00

Part A

Answer ALL Questions **(10x2=20)**

1. How do you explain nuclear fission from the binding energy -mass number graph?
2. Write a short note on conventional energy sources.
3. Explain the use of control rods in nuclear reactors.?
4. Derive prompt critical condition,when the reactor is critical.
5. What is Radioactivity? Give its units.
6. Explain the terms fissile nuclei and fissionable nuclei.
7. Find the Binding energy per nucleon of Fe^{56} nucleus. (Given that mass of $_{26}Fe^{56}$ =55.9349)
8. Show that second moment of a probability distribution of neutron is equal to six times square of diffusion length.
9. Distinguish between thermal reactors and fast reactors.
10. Calculate the power output of a nuclear reactor which consumes 10 Kg of $_{92}U^{235}$ per day.Given that the energy released per fission is 200MeV.

PART B

Answer ANY FOUR questions. **(4x7.5=30)**

11. A bare reactor consists of long rods of uranium metals 25.4mm diameter, arranged in a square lattice with a pitch of 0.152 m suspended in a cylindrical vessel containing heavy water as moderator.(H/D=1.2).From the properties of the materials, B_m^2 is known as to be $8.6m^{-2}$ .Estimate the mass of the natural uranium that will make the reactor just critical.(Density of Uranium=$1.9x10^3 Kg/m^3$).
12. Show that a good approximation for lethargy, average increase in lethargy in any moderator (acts as an isotropic scatter)is 2/(A+2/3),where A is the mass number of the nucleus.
13. Derive Fermi age equation and discuss its boundary condition.
14. Explain the different types of Nuclear reactors.
15. State and explain reciprocity theorem .
16. Using Fick's law ,derive the steady state diffusion equation.

PART C

Answer ANY FOUR questions **(4x12.5=50)**

17. Explain "neutron balance" and discuss the condition for criticality in a reactor.
18. a. What do you mean by "Buckling "in a reactor? In the case of thermal reactor show that the material and geometric bucklings are equal. (5)
    b. Derive expression for flux and buckling of a critical rectangular parallelepied reactor? (7.5)
19. Derive the reactivity equation in the case of an infinite reactor with delayed neutrons. Discuss the nature of roots in the reactivity equation.
20. Write down the steady state diffusion equation and solve it for an infinite planar source.
21. Discuss the modified one group theory and hence derive an expression for the reactivity worth of a small central cylindrical control rod.
22. Breifly describe the relation connecting temperature coefficient and reactivity of a reactor, and obtain an expression for the temperature coefficient in terms of multiplication factor.

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