2017
PHYSICS
Paper : 402

NUCLEAR PHYSICS - III

Full Marks: 80

Time: 3 hours

The Figures in the margin indicate full marks for the questions

1. Answer the following (Any fve)   2 x 5 = 10

    (a) What do you mean by moderator used in nuclear fission reactor?

    (b) What do you meant by sub-critical, critical and super-critical conditions in case of a fission reactor ?

    (c) What is nuclear magnetic resonance (NMR) ?

    (d) What is meant by ionizing and non-ionizing radiation ?

    (e) What is Relative Biological E"ectiveness (RBE) ?

    (f) Define absorbed dose. Write its SI unit.

2. Answer the following (Any six)   5 x 6 = 30

    (a) Write down the classifcation of neutrons on the basis of their energies.   5

    (b) Calculate the average number of collisions by neutrons in graphite (^{12}C) required to reduce the neutron energy from 2 MeV to 0.025 eV.   5

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(c) Write down various characteristics of fission reaction.   5

(d) If the average amount of energy released per fission is 200 MeV, what amount of energy in kWh would be generated by fissioning 1 Kg of U-235.   5

(e) What do you mean by fusion barrier. What temperature should be required for ^{12}C to overcome the fusion barrier to form ^{24}Mg nucleus.   1+4=5

(f) What is the mechanism of production of elements beyond A > 56. Discuss s and r-processes with suitable examples.   1+4=5

(g) What are the different shielding materials used for different ionizing radiations. How much lead shielding must be used to reduce the exposure rate from an I-131 source from 32 mR/Hr to 2mR/H. The HVL (half value layer) for I-131 is 0.178 cm.   2+3=5

(h) What is gravitational red shift. Discuss briefly how Mossbauer spectroscopy can be used to measure the gravitational red shift.   1+4 =5

3. Answer the following (Any four)   10 x 4 = 40

(a) Discuss the mechanism by which neutron looses energy in a medium. Show that for neutrons traversing through a medium, the *mean fractional energy loss* is independent of the incident energy of neutron.   2+8=10

(b) Write short note on PP-chain and CNO cycle.   6+4=10

(c) Derive the four factor formula for a fission reactor. How four factor formula will be modified for a reactor of finite size.   8+2=10

(d) Write short note on biological effects of ionizing radiations. What is the effective dose of a worker who receives uniform whole body dose of 20 mGy of 1 MeV neutron and 10 mGy of α-rays.   7+3=10

(e) What is Mossbauer effect ? With neat diagram, discuss briely the experimental arrangement needed for Mossbauer resonent absorption. Hg-198, attached to a rotor of radius 2 cm, emits γ-ray of energy 412 KeV. Estimate the number of revolution per second of the rotor so that the energy of the γ-ray is Doppler shifted by an amount equal to twice the recoil energy of the nucleus.   2+3+5=10

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