Reg. No.										

MANIPAL
ACADEMY of HIGHER EDUCATION

DEPARTMENT OF SCIENCES, IV SEMESTER M.Sc. (PHYSICS)
END SEMESTER EXAMINATIONS, APRIL 2018

Subject: Nuclear Physics III [Code: PHY 708.6]
(REVISED CREDIT SYSTEM-2017)

Time: 3 Hours Date: MAX. MARKS: 50

Note: (i) Answer **Any FIVE full** questions
(ii) Draw diagrams, and write equations wherever necessary

1. (a) Obtain an expression for the quadrupole moment of the nucleus.
(b) Show that for a homogeneous ellipsoid of semi axes *a, b* the quadrupole moment is given by $Q = (2/5)\, Ze\, (a^2 - b^2)$ where a is the length of the semi-major axis and 'b' is the length of the semi-minor axis. Show that the electric quadrupole moment of a nucleus vanishes for a spherically symmetric charge distribution. [5+5]

2. (a) Derive Fermi age equation for diffusion of neutrons.
(b) Obtain Four Factor formula in the design of a nuclear reactor. [5+5]

3. (a)

A beam of 2 MeV neutrons is used to give the reaction ${}^{14}_{7}\mathrm{N} + {}^{1}_{0}n \rightarrow {}^{11}_{5}\mathrm{B} + {}^{4}_{2}\mathrm{He}$. Determine

(a) The threshold energy of this reaction
(b) The maximum energy of the α-particles

Given the atomic masses in amu: ${}^{14}_{7}\mathrm{N} = 14.003074$; ${}^{1}_{0}n = 1.008665$; ${}^{4}_{2}\mathrm{He} = 4.002603$; ${}^{11}_{5}\mathrm{B} = 11.009305$; amu = 931.6 MeV.

(b) What are magnetic mirror? Write a note on confinement of Plasma.

[5+5]

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4. With the help of a neat diagram explain Hofstadter's Electron diffraction experiment to determine the radius of the nucleus. [10]
5. Write short notes on the following: (a) Lawson's criterion (b) Pinch effect. (c) Thermonuclear reactions [3+3+4]
6. (a) Obtain the formula for the average log energy decrement of neutrons.
   (b) Calculate the number of collisions required to reduce fast fission neutrons with an average initial energy of 2 MeV to the thermal energy (0.025 eV) in a graphite moderated assembly. [ξ =0.155 for graphite]
   (c) Calculate the number of collisions required for neutrons of 2 MeV to lose 99 % of initial energy in graphite. [ξ =0.155 for graphite] [5+3+2]