MANIPAL
ACADEMY of HIGHER EDUCATION
(Deemed to be University under Section 3 of the UGC Act, 1956)

Reg. No.

DEPARTMENT OF SCIENCES MAHE
IV SEMESTER, END SEMESTER EXAMNATIONS
APRIL 2018
Subject: NUCLEAR PHYSICS II (PHY-706.6)
(REVISED CREDIT SYSTEM)

Time: 3 Hours Date: APRIL 2018 MAX. MARKS: 50

Note: (i) Answer any FIVE FULL questions.
(ii) Answer the questions to the point.

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1. (a) Using meson particle exchange model obtain the Yukawa potential expression for nuclear forces. [6]
(b) The magnetic moments of proton, neutron, and deuteron are 2.79281±0.00004 nm, -1.913148±0.000066 nm, and 0.8797±0.00015 nm respectively. What nature of nuclear force you can infer from this data? [4]

2. (a) Obtain expression and value of the ground state energy of deuteron nucleus. [6]
(b) Write a short note on scattering length. [4]

3. (a) How is the nuclear shell model useful to estimate the spin and parity of a nucleus? [5]
(b) Find the total number of nucleons from all shells $N = 0$ to $N = N_{max}$ being filled and hence, calculate the spacings between oscillator levels. [5]

4. (a) Write the collective model Hamiltonian. What does $\lambda = 0, 1, 2$ mode oscillations mean? What are the angular momentum and parity of such motions? Draw atleast five vibrational energy levels with spin - parity for any one nucleus. [5]
(b) Show that the inertial parameter $B_{lambda} = \rho {r_o}^5/\lambda$ for nuclear fluid motion, where ρ is the nuclear density, r_o is the radius of the spherical drop, and λ is the order of deformation from spherical equilibrium shape. [5]

5. (a) Consider the reaction of the type X(x,y)Y and employ the standard perturbation theory to calculate cross - section in terms of nuclei involved in reaction process. Also consider the spin of particles/nuclei. [7]
(b) How does the optical potential explain the scattering and absorption phenomena in nuclear reactions simultaneously? [3]

6. (a) Obtain the expression of the Breit - Wigner formula for s wave scattering by spinless nuclei. [6]
(b) Write a short note on direct nuclear reactions. [4]
