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

DEPARTMENT OF SCIENCES, II SEMESTER M.Sc. (PHYSICS)
END SEMESTER EXAMINATIONS, APRIL/MAY 2019

NUCLEAR AND PARTICLE PHYSICS [PHY 4208]
(REVISED CREDIT SYSTEM-2017)

Time: 3 Hours Date:02.05.2019 MAX. MARKS: 50

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

1A. How to estimate nuclear size using mirror nuclei method. [5]

1B. Obtain momentum distribution function for beta decay and hence sketch beta ray spectra. [5]

2A. Explain energy straggling for a beam of monoenergetic charged particles traversing through the matter. [5]

2B. Explain working principle of inorganic scintillation radiation detector with the help of band diagram? [5]

3A. What are magic numbers. Explain. [3]

3B. Explain any one of the evidences for shell structure of the nucleus? [2]

3C. For Bi (Z=83, A=209), compute total binding energy and coulomb energy using semi empirical mass formula. [5]

Use:

$$B(A,Z) = a_v A - a_s A^{2/3} - a_c \frac{Z(Z-1)}{A^{1/3}} - a_{sym} \frac{(A-2Z)^2}{A} + \delta \begin{cases} a_p A^{-3/4} & \text{even} - \text{even} \\ 0 & \text{even} - \text{odd} / \text{odd} - \text{even} \\ -a_p A^{3/4} & \text{odd} - \text{odd} \end{cases}$$

$a_v = 15.5\text{MeV}$
$a_s = 16.8\text{MeV}$
$a_c = 0.72\text{MeV}$
$a_{sym} = 23\text{MeV}$
$a_p = 34\text{MeV}$

4A. Obtain a relation between angles and nuclear reaction cross section in lab and center of mass system. [3]

4B. What is spin dependence property of nuclear force? Explain. [2]

4C. Solve the following.

The reaction $^3\text{H}(d, n)^4\text{He}$ has Q value of 17.6 MeV. What is the range of neutron energies that may be obtained from this reaction for an incident deuteron beam of 300 KeV?

Use:

For the reaction $X(a, b)Y$,

$$Q = E_b\left(1 + \frac{m_b}{m_Y}\right) - E_a\left(1 - \frac{m_a}{m_Y}\right) - \frac{2}{m_Y}\sqrt{m_a m_b E_a E_b}\cos\theta$$

[5]

5A. Classify and explain fundamental forces of nature. [4]

5B. Write quark structure of neutron and meson. [2]

5C. Calculate the energy of 1 MeV gamma ray photon after Compton scattering through 90 degree. [4]