Roll No. ....

MSCPHY-12 (M.Sc. PHYSICS)

Second Year Examination-2015

PHY-551

Nuclear Physics and Analytical Techniques

Time : 3 Hours **Maximum Marks :** 60

Note : This paper is of sixty (60) marks divided into three (03) sections A, B, and C. Attempt the questions contained in these sections according to the detailed instructions given therein.

Section - A

(Long Answer Type Questions)

Note : Section 'A' contains four (04) long-answer-type questions of fifteen (15) marks each. Learners are required to answer any two (02) questions only. (2×15=30)

1. Explain Fermi's theory of β decay.
2. What are exact conservation laws and approximate conservation laws.
3. Describe shell model and give the main assumptions of shell model and its predictions.
4. Explain how the nuclear magnetic resonance is achieved in practice. To what characteristics energy is the NMR technique sensitive.

Section - B

(Short Answer Type Questions)

Note : Section 'B' contains eight (08) short-answer-type questions of five (05) marks each. Learners are required to answer any four (04) questions only. (4×5=20)

1. Give an account of intraction of photons with matter. Which is the effect used to detect r ray and measure their energy in a scintillation detector like NaI Crystal?

2. A Neution beam is incident on a stationary target of 19 F atoms. The reaction F(n, p) ^{19}O has Q value of -3.9 mev. Calculate the lowert neutrion energy which will make this reaction possible.

3. Explain Pauli's neutrino hypothesis.

4. Caculate the activity of one gram of radium $^{226}_{88}$Ra whose half life is 1622 years.

5. Explain why α particles exhibit a definite range in matter.

6. Give the schematic sketch of TEM. Explain the construction and working of TEM.

7. Explain how isomer shift arises in a Mossbauer spectrum. Discuss the usefulness of invner shift in understanding the spin state of mossbauer nuclic in a sample.

8. How NMR phenomena can be explained in a simple way to get clear physical picture calculate the magnetic field produced by a nucleus having a magnetic moment of 10 nuclear magnetons at a distance of 2.15 A^o from it.

Section - C

(Objective Type Questions)

Note : Section 'C' contains ten (10) objective-type questions of one (01) mark each. All the questions of this section are compulsory. (10×1=10)

1. The contribution of coulomb energy in the semiempirical mass formula of a nucleus of mass number A and atomic number Z is of form (a=constant).

   (a) $aZA^{2/3}$ (b) $aZ(Z-1)/A^{1/3}$

   (c) $aZ(Z+1)/A$ (d) $aZ^2/A^{2/3}$

2. What is the average binding energy of a nucleon in the nucleus of an atom ?

   (a) 7.8 ev (b) 7.8 KeV

   (c) 7.8 MeV (d) 7.8 BeV

3. From meson field theory the potential energy of interaction between two nucleons is proportional to

   (a) $e^{-\mu r}/r^2$ (b) $e^{-\mu r}/r$

   (c) $e^{-\mu r}/r^3$ (d) $e^{-\mu r^2}/r$

4. An admissible potential between the proton and the neutron in a deuteron is

   (a) Coulomb (b) Harmonic Oscillator

   (c) Finite square well (d) Infinite square well

5. Which of the following statement is <u>incorrect</u> for the nuclear force between two nucleons?

   (a) It is charge independent

   (b) It is spin independent

   (c) It is velocity dependent

   (d) It has non central component

6. The nuclear reaction

$$4\,{}_1H^1 \rightarrow {}_2\,He^4 + 2\,{}_{-1}e^0 + 26\,\text{Mev}$$

represents

(a) Fusion (b) Fission

(c) β-decay (d) r-decay

7. The half life of one of the atoms of a radio active sample is

(a) $\frac{\ln_2}{\lambda}$ (b) λ

(c) $\frac{\ln\lambda}{2}$ (d) $\lambda/2$

8. When an electron and position annihilate

(a) Nothing is created

(b) One photon created

(c) Two photons are created

(d) Two neutrons are created

9. In Fermi theory of β decay, the number of emitted electrons with momentum p and energy E, in the allowed approximation, is proportional to:

(a) $(E_0\text{-}E)$ (b) $p(E_0\text{-}E)$

(c) $P^2(E_0\text{-}E)^2$ (d) $p(E_0\text{-}E)^2$

Where E_0 is the total energy given up by the nucleus.

10. The scientillation counter:

(a) Is not used for counting α particles

(b) counts only β particles

(c) counts only r particles

(d) uses a material which emits light when a changed particle strikes it