Roll No. .....

(07/21-II)

11851

M. Sc. EXAMINATION

(For Batch 2017 & Onwards)

(Fourth Semester)

PHYSICS

PHY-401

Nuclear and Particle Physics

Time : Three Hours *Maximum Marks :* 70

Note : Attempt *Five* questions in all, selecting *one* question from each Unit. Q. No. **1** is compulsory. All questions carry equal marks.

(Compulsory Question)

1. (a) What do you understand by charge symmetry and charge independence of nuclear forces ? 2

(b) The ^{7}Be nuclide is unstable having half-life 53.3 days. It decays into ^{7}Li through electron capture. Why does it not decay by positron emission ? 2

(c) The binding energy of $_{12}Mg^{24}$ is 198.25 MeV. Find its atomic mass. 2

(d) In hadrons and anti-hadrons the quarks are assigned some colors but it is never directly observables in the outside world. Why ? 2

(e) State the conservation principles violated by the following reactions :

(i) $\Lambda^{\circ} \rightarrow \pi^{+} + \pi^{-}$

(ii) $p + p \rightarrow \Lambda^{\circ} \rightarrow \Sigma^{+} + p$. 2

(f) The free neutron is not stable while proton is. What is the reason for stability of a free proton ? Also write the channel for decay of a neutron. 2

(g) Predict the ground state spin of ^{13}C and ^{10}Be using shell model. 2

Unit I

2. Write the different properties of a deuteron system. With square well potential for the ground-state of deuteron, establish the relation $V_0 r_0^2 \approx \pi^2 \hbar^2 / 4M$. 14

3. Discuss the meson theory for nuclear forces. Also deduce the relation between the range of the force and mass of exchange particle. 14

Unit II

4. Explain liquid drop model. Also show that how the inclusion of asymmetry and pairing term in this model is essential in order to predict the binding energy curve. 14

5. Give the evidences for shell model. Discuss shell model of the nucleus. Also show that how the inclusion of spin orbit coupling reproduce the magic number. 14

Unit III

6. (a) In which nuclei beta decay occurs ? Discuss Fermi theory for beta-decay. 10

   (b) What is Internal Conversion ? How does it compete with gamma emission process ? 4

7. (a) Discuss mass and energy balance in nuclear reactions. What do you mean by Q value of a reaction ? 7

   (b) Why are alpha particles emitted rather than individual protons or $_2He^3$ nuclei ? Deduce an expression for disintegration energy and kinetic energy of alpha particle. 7

Unit IV

8. (a) Discuss the quark structure of hadrons. Also discuss the concept of color quantum number. 7

   (b) Write a note on Charge conjugation, parity and CPT theorem. 7

9. (a) Discuss the conservation of baryon, lepton and strangeness number with suitable examples for the reactions involving elementary particles. 7

   (b) What are the parameters to classify the elementary particles ? Give the classification scheme of elementary particle on the basis of spin quantum number. 7