

[57/A-10] SEAT No. \_\_\_\_\_

No. of printed pages: 02

**SARDAR PATEL UNIVERSITY**  
**M.Sc. (PHYSICS) (IV<sup>th</sup> – Semester) Examination**  
**Day & Date: Monday & 18/03/2019**  
**Time: 10:00 AM to 01:00 PM**  
**Title: NUCLEAR AND PARTICLE PHYSICS**  
**Course Code: PS04CPHY01**

**Instruction:** Figures to the right indicate marks.

**Total Marks: 70**

**Q.1 Write answer of all questions by showing your choice against the question number. [8]**

- (1) The following constituent does not contribute to the magnetic moment of deuteron.
 

(a) orbital motion of neutron	(b) intrinsic spin of individual nucleon
(c) orbital motion of proton	(d) all of them
  
- (2) The binding energy per nucleon in the case of  $^{56}_{26}\text{Fe}$  nucleus is \_\_\_\_\_ MeV/nucleon.
 

(a) 3.8	(b) 8.7	(c) 10.3	(d) 931.6
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- (3) The  $\alpha$  - decay Bragg-curve has a maximum ionization at its end, this maximum ionization arises due to the phenomenon known as
 

(a) struggling	(b) disintegration	(c) straggling	(d) none of them
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- (4) A free neutron outside a nucleus undergoes a \_\_\_\_\_ - decay.
 

(a) $\beta^+$	(b) $\beta^-$	(c) Electron-capture	(d) none of them
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- (5) The relation between the range and life time of  $\alpha$  - emitter nuclei is known as
 

(a) Geiger-Nuttal law	(b) Gamow-Teller law
(c) Bohr-Mottelson relation	(d) Katz-Penfold relation
  
- (6) The leptonic number for positron is \_\_\_\_\_.
 

(a) - 1	(b) 0	(c) 1	(d) $\frac{1}{2}$
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- (7) The exchange particles responsible for the colour interactions are
 

(a) coloured gluons	(b) photons	(c) mesons	(d) quarks
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- (8) The gauge bosons responsible for the strong interaction are known as.
 

(a) gluons	(b) gravitons
(c) neutrinos	(d) mesons

**Q.2 Attempt any Seven of the followings:**

[14]

- (1) Explain isomerism by shell model.
- (2) Explain experimental properties of the deuteron.
- (3) Discuss Q-values in orbital electron capture process.
- (4) Discuss in short nuclear fission mechanism.
- (5) Explain the selection rules in the case of  $\beta$  - decay transitions.
- (6) What is Fermi-Kurie plot? What type of information does it provide in case of  $\beta$  - decay?

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- (7) Explain PPI cycle of proton burning inside the Sun.
- (8) What is compound nucleus? Write a nuclear reaction where in compound nucleus is formed.
- (9) Extend the Gellmann-Nishijima formula to incorporate charm quark flavor and using it obtain the charge of the charm quark.

**Q.3(a)** Discuss the successes and failures of the single particle shell model. Discuss how the collective model explains the shortcomings of the single particle shell model. [6]

**Q.3(b)** Using necessary equation derive magnetic moment of deuteron. [6]

**OR**

**Q.3(b)** In the collective nuclear model discuss vibration of spherical nuclei. [6]

**Q.4(a)** Explain range –energy relationship in  $\alpha$  - particles and what is Geiger-Nuttal law? [6]

**Q.4(b)** Discuss the continuous spectrum and neutrino hypothesis in  $\beta$  - decay. [6]

**OR**

**Q.4(b)** Discuss in detail the electromagnetic transitions in nuclei. [6]

**Q.5(a)** Discuss in details the nucleo-synthesis in stars. [6]

**Q.5(b)** Discuss the general features of a nuclear reactor. Explain how the nuclear reactors are classified. [6]

**OR**

**Q.5(b)** Discuss the main components of a nuclear reactor and discuss each of them in short. [6]

**Q.6(a)** Based on the fundamental interaction forces classify the elementary particles. [6]

**Q.6(b)** Discuss Gell-Mann's SU(3) Quark Model for hadrons. Explain its successes and failures. How is it improved? [6]

**OR**

**Q.6(b)** Describe the various nuclear techniques employed in the diagnostic and therapeutic applications of nuclear medicine. [6]

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