



Seat No. \_\_\_\_\_

**HI-003-0494003**  
**B. Sc. / M. Sc. (Applied Physics)**  
**(Sem.-IV) (CBCS) Examination**  
**April - 2023**  
**Paper-XIV : Applied Nuclear Physics**  
*(New Course)*

**Faculty Code : 003**  
**Subject Code : 0494003**

Time :  $2\frac{1}{2}$  Hours / Total Marks : 70

**Instructions :**

- (1) All questions are compulsory.
- (2) Numbers in the right margin indicate marks.

- 1** (a) Answer the following multiple choice questions : **4**
- (1) What is the main advantage of using a scintillation counter over a bubble chamber ?
    - (A) Scintillation counters are more sensitive to particles.
    - (B) Scintillation counters are faster in detecting particles.
    - (C) Scintillation counters are cheaper than bubble chambers.
    - (D) Scintillation counters can detect particles with lower energy.
  - (2) Which of the following acts as ionizing gas in Geiger Muller counter ?
    - (A) Alcohol
    - (B) Argon gas
    - (C) Krypton
    - (D) Hydrogen

- (3) What is the main function of a particle accelerator ?
- (A) To detect particles
  - (B) To generate high-energy particles.
  - (C) To measure the mass of particles.
  - (D) To study the properties of particles.
- (4) What is the main principle behind a bubble chamber ?
- (A) Scintillation      (B) Ionization
  - (C) Boiling            (D) Magnetism

(b) Answer the following questions in brief : 2

(any **one** out of two)

- (1) Write applications of particle detectors.
- (2) List various types of particle detectors.

(c) Answer the following questions in detail : 3

(any **one** out of two)

- (1) Write the difference between active and passive particle detectors.
- (2) Write the principle of a cloud chamber. What are its limitations ?

(d) Write a detailed note : (any **one** out of two) 5

- (1) Discuss the principle and construction of a GM counter.
- (2) Explain the construction and working of cyclotron.

2 (a) Answer the following multiple choice questions : 4

- (1) What type of particle is responsible for the strong nuclear force that holds the nucleus together ?
- (A) Electrons            (B) Protons
  - (C) Neutrons            (D) Gluons

- (2) What type of particle is considered to be the basic building block of matter ?
- (A) Electrons            (B) Protons  
(C) Neutrons            (D) Quarks
- (3) Hardon composed of two up quarks and one down quark
- (A) Proton                (B) Zero  
(C) Quarks flavors      (D) None of the mentioned
- (4) What is the main difference between neutrinos and antineutrinos ?
- (A) Neutrinos have a positive charge, while antineutrinos have a negative charge.  
(B) Neutrinos have a negative charge, while antineutrinos have a positive charge.  
(C) Neutrinos have no charge, while antineutrinos have a positive charge.  
(D) Neutrinos have no charge, while antineutrinos have a negative charge.

(b) Answer the following questions in brief : 2

(any **one** out of two)

- (1) What are Hadrons ?  
(2) Write a note on color of elementary particles.

(c) Answer the following questions in detail : 3

(any **one** out of two)

- (1) What are leptons ?  
(2) What is flavours of elementary particles ?

(d) Write a detailed note on the given questions : 5

(any **one** out of two)

- (1) Write a note on field bosons.  
(2) Explain the standard model.

- 3 (a) Answer the following multiple choice questions : 4
- (1) What is the most widely accepted theory to explain the origin of the universe ?
    - (A) Big Bang Theory
    - (B) Steady State Theory
    - (C) Chaotic Inflation Theory
    - (D) Cyclic Model
  - (2) What is the main source of light in the universe ?
    - (A) Stars (B) Galaxies
    - (C) Quasars (D) Black holes
  - (3) The cooling agent for the MRI magnet is \_\_\_\_\_
    - (A) Helim (B) Neon
    - (C) Argon (D) Xenon
  - (4) The Mossbauer effect based on :
    - (A) Doppler effect (B) Beer-Lamberts law
    - (C) Mossier effect (D) Spin effect
- (b) Answer the following questions : (any **one** out of two) 2
- (1) What is Doppler broadening for Mossbauer spectroscopy ?
  - (2) Write applications of Mossbauer Spectroscopy.
- (c) Answer the following questions in detail : 3  
(any **one** out of two)
- (1) What is recoil-free nuclear resonance absorption ?
  - (2) Explain gamma knife with necessary figure.
- (d) Write a note on the given questions : (any **one** out of two) 5
- (1) Write a detailed note on Magnetic Resonance Imaging.
  - (2) Explain positron emission tomography with necessary figures.

4 (a) Answer the following multiple choice questions : 4

- (1) What is the age of the universe estimated to be, according to current scientific knowledge ?  
(A) 10 billion years (B) 12 billion years  
(C) 14 billion years (D) 16 billion years
- (2) What is dark matter believed to be composed of ?  
(A) Ordinary matter  
(B) Antimatter  
(C) Mysterious particles  
(D) Black holes
- (3) Van Allen belt around earth is formed because of earth's  
(A) Gravitational field  
(B) Magnetic field  
(C) Mass  
(D) Angular momentum
- (4) Which of the following is not an implication of Hubble's law ?  
(A) The universe is expanding  
(B) We are in the center of the universe  
(C) The universe had a beginning  
(D) The universe was once denser than it is

(b) Answer the following questions in brief : 2

(any **one** out of two)

- (1) Discuss secondary cosmic rays.
- (2) Give the name of two hypotheses for the basis of cosmological principles assumed in all cosmological theories.

- (c) Answer the following questions in detail : 3  
(any **one** out of two)
- (1) What is Van-Allen belt ? Discuss using schematic diagram.
- (2) Write a short note on Evolution of stars.
- (d) Write a detailed note : (any **one** out of two) 5
- (1) Explain big bang theory.
- (2) Discuss the geomagnetic effect for cosmic rays.
- 5** (a) Answer the following multiple choice questions : 4
- (1) Sun's radiant energy is due to
- (A) Nuclear Fusion  
(B) Nuclear Fission  
(C) Photoelectric Effect  
(D) Radioactive Decay
- (2) What type of particle accelerator is used to produce intense beams of X-rays ?
- (A) Linear accelerators  
(B) Free Electron Lasers (FEL)  
(C) Synchrotrons  
(D) Both (B) and (C)
- (3) What is the main purpose of using a cooling system in a bubble chamber ?
- (A) To detect particles  
(B) To generate high-energy particles  
(C) To keep the temperature constant  
(D) To study the properties of particles
- (4) Which of the following best define nuclear forces ?
- (A) The attraction between protons and neutrons  
(B) Repulsion between protons and neutrons  
(C) The attraction between protons and electrons  
(D) The attraction between electrons and neutrons.

- (b) Answer the following questions in brief : **2**  
(any **one** out of two)
- (1) What is the advantage of gamma knife ?
  - (2) Write the advantages of nuclear energy.
- (c) Answer the following questions in detail : **3**  
(any **one** out of two)
- (1) Write a short note on Quarks.
  - (2) Explain construction and working of synchrotron.
- (d) Write a detailed note : (any **one** out of two) **5**
- (1) Write a detailed note on the Van-de-graph generator.
  - (2) Explain Mossbauer spectroscopy in detail.
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