

[This question paper contains 4 printed pages.]

Your Roll No.

5112

B.Sc. Prog. / III B

PH-302 – PHYSICS – MODERN PHYSICS

(Admissions of 2008 and onwards)

Time : 3 Hours

Maximum Marks : 75

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt five questions in all.

Question No. 1 is compulsory.

1. Attempt any **five** of the following :
 - (a) Calculate the de Broglie wavelength of an alpha particle moving with an energy of 10 GeV.
 - (b) Explain the terms 'Stimulated emission' and 'Induced emission', clarifying the difference.
 - (c) What do you understand by 'Wave function' ? Give two of its properties.
 - (d) Explain the reason for the failure of classical mechanics.
 - (e) What are quarks ? Name the various types of quarks.

- (f) Name two Leptons and one Hadron.
- (g) State Larmors Theorem.
- (h) How does pressure vary with altitude ?
Explain with a graph. 3 × 5
2. (a) Obtain solutions for the Schrödinger wave equation for a free particle. 7
- (b) Deduce the eigen values for a particle in a box and comment if the energy values need to be discrete. 6, 2
3. (a) Explain the following terms :
(i) Operation in Quantum Mechanics
(ii) Fine Structure 4, 4
- (b) Why is Anomalous Zeeman effect considered to be Anomalous ? Explain with a diagram, how it differs from normal Zeeman effect. 2, 5
4. Describe Stern-Gerlach experiment. What was the finding of this experiment ? Give appropriate diagrams showing the difference when the field is (i) ON and (ii) OFF. 15
5. (a) Explain the following :
(1) Geiger-Nuttall Law
(2) α -Decay 3, 3
- (b) Explain with a graph the variation of binding energy per nucleon versus atomic mass number. Identify the regions of the graph which are conducive to (i) Fusion and (Fission). 4

- (c) Given the following masses for the isotopes of Lithium. Calculate the Binding energy of a neutron in the ${}_3\text{Li}^7$ nucleus. Express the results in u, MeV and Joules.

$${}_3\text{Li}^7 = 7.016004 \text{ u}$$

$${}_3\text{Li}^6 = 6.015125 \text{ u}$$

$${}_0\text{n}^1 = 1.008665 \text{ u}$$

5

6. (a) What is a Laser ? Give three properties of a Laser. Explain with a diagram the principle of (i) Three level laser and (ii) Four level laser. Which type of laser is the He-Ne laser ? 2, 3, 4, 1
- (b) Explain any two applications of Laser, explaining the advantages or disadvantages over conventional methods. What are the precautions you would follow if you were using a Laser for these applications ? 4, 1
7. (a) Name the four types of fundamental interactions, mentioning (i) the particles which are affected and (ii) the particles which are exchanged, which is the strongest and which one the weakest of these four ? Which two has the longest range ? 4, 2, 1
- (b) Look at the following reactions. State if these reactions violates any conservation laws and mention the law, which is violated.
- (i) $P + p \rightarrow P + \Lambda^0 + \Sigma^+$ 4
- (ii) $\pi^- + p \rightarrow n + \pi^0$ 4

8. (a) Explain with a graph, the variation of temperature with altitude, how does this graph relate to the absorption of solar radiation at various levels. 7
- (b) Write down four factors that have contributed to global warming in their order of importance. Explain the cause and effect of these factors. 4, 4

PHYSICAL CONSTANTS

$$C = 3 \times 10^8 \text{ ms}^{-1}, \quad m_e = 9.1 \times 10^{-31} \text{ kg}$$

$$e = 1.6 \times 10^{-19} \text{ C}, \quad m_n = 1.00866 \text{ u}$$

$$h = 6.6 \times 10^{-34} \text{ Js}, \quad m_p = 1.00728 \text{ u}$$
