

**B.TECH.****THEORY EXAMINATION (SEM–VIII) 2016-17****CONCEPTS OF MODERN PHYSICS****Time : 3 Hours****Max. Marks : 100****Note : Be precise in your answer. In case of numerical problem assume data wherever not provided.****SECTION – A****1. Attempt the following:****10 x 2 = 20**

- (a) What is the wave particle duality?
- (b) What is the law of conservation?
- (c) What is Hubble's law?
- (d) Write the short note on solar system.
- (e) What is the dark matter and dark energy?
- (f) Explain the kepler's law.
- (g) What is meant by Time-dilation and twin-paradox?
- (h) What is the X-ray Crystallography?
- (i) Describe the Bohr's atomic-model.
- (j) Explain in short LHC at CERN.

**SECTION – B****2. Attempt any five parts of the following questions:****5 x 10 = 50**

- (a) Draw the curve showing binding energy per nucleon versus mass number of nucleus. Explain how Fusion and Fission reactions both produce energy. Give examples of both the processes.
- (b) An electron of mass equivalent energy ( $m_0c^2$ ) 0.51 MeV is moving with a velocity of  $0.5c$ . Find its kinetic energy (in MeV), using the relativistic kinetic energy formula.
- (c) Write a brief history of universe from big-bang to, say, black-hole, with emphasis on the first 3 minutes of nucleo-synthesis.
- (d) As per Feynman, the forces are due to exchange of messenger particles. Draw Feynman diagrams to show the electromagnetic force, weak nuclear force and strong force, clearly showing the respective exchange (messenger) particles. What is the suggested messenger particle for gravity?
- (e) Explain Gell-Mann quark model of nucleons. Also explain the color and flavor and its importance. Comment on the statement that 'all baryons and mesons are colorless'.
- (f) Explain the working and construction of Ruby laser.
- (g) Explain wave particle duality, beginning with the question 'what is light; particle or wave?' Answer it briefly with the approaches of Newton, Huygens and then of Einstein. Write the de-Broglie hypothesis and its formula. Explain briefly, how this introduced the way particle duality even for a moving particle (such as electron) and show that how this hypothesis is compatible with the Bohr's quantization of angular momentum.
- (h) What is the De-Broglie matter wave? Calculate de-broglie wave length associate with a proton moving with a velocity equal to  $1/20$  th of the velocity of light.

### SECTION – C

**Attempt any two parts of the following questions:**

**2 x 15 = 30**

- 3** Considering the time-independent Schrodinger's wave equation in one dimension, for particle in a box; derive and plot the expressions for the energy levels  $E_n$  and the wave function  $\psi$ .
- 4** Write Maxwell equations and derive that the velocity of electromagnetic wave (light) is related to electric and magnetic constants,  $\epsilon$  and  $\mu$  as  $c = 1/\sqrt{(\epsilon \cdot \mu)}$ .
- 5** Spacecraft Alpha is moving at  $0.9 c$  with respect to earth. If another spacecraft Beta is to pass Alpha at a relative velocity of  $0.5 c$  in the same direction, what speed Beta must have with respect to earth, as per relativistic velocity addition formula.