Code : 221201

B.Tech. 2nd Semester Exam., 2014

PHYSICS

Time : 3 hours | *Full Marks* : 70

Instructions :

(i) All questions carry equal marks.

*(ii) There are **NINE** questions in this paper.*

*(iii) Attempt **FIVE** questions in all.*

*(iv) Question No. **1** is compulsory.*

1. Answer any *seven* subquestions of the following :

(a) Calculate the average value of Poynting vector at the surface of the sun if the power radiated by the sun is 4×10^{25} W and its radius is 7×10^{8} m.

(b) A meter scale is moving along its length with a velocity 0·8 C. Calculate its length as it appears to an observer on the earth.

(c) Calculate Compton shift if X-rays of wavelength 1·0 Å are scattered from a carbon block. The scattered radiation is viewed at 90° to the incident beam.

(d) Write Rayleigh–Jeans formula for black-body radiation and identify the terms.

(e) Explain stimulated emission of radiation in laser.

(f) Establish a relation between coherence length and linewidth.

(g) An optical filter has a linewidth of 1·5 nm and mean wavelength 550 nm with white light incident on the filter, calculate coherence length.

(h) What is optic axis? What is its significance?

(i) A laser is essentially a converter of energy. Explain.

(j) A particle of mass 0·2 mg is in a one-dimensional potential well of width 1 mm. Find the ground state energy.

2. *(a)* Describe briefly Michelson-Morley experiment and the significance of the experimental results.

(b) Establish Einstein mass-energy relation.

3. *(a)* Prove that classical theory does not hold in the region of atomic dimension.

(b) State the characteristics of black-body radiations.

(c) Show graphically how the energy density vs. freq. plot of black-body radiations is changed if the temperature is increased.

(Continued)

4. (a) Explain the wave-particle duality phenomenon.

(b) State de Broglie hypothesis and prove it.

(c) Calculate the wavelength associated with an electron having an energy of 1000 eV.

5. (a) State the differences between laser and normal light.

(b) What are the different transition processes involved with lasing action?

(c) State some applications of laser.

6. (a) Explain briefly Huygens's principle for the propagation of light.

(b) Derive an expression for the intensity distribution due to Fraunhofer diffraction at a single slit.

7. (a) Explain the phenomenon of double refraction in uniaxial crystal.

(b) Describe the construction of a Nicol prism and show how it can be used as a polarizer and as an analyzer.

8. What do you understand by nanoparticles? Based on *I-V* characteristic, discuss the electrical properties of nanoparticles.

9. Write short notes on any *two* of the following :

(a) Ruby laser

(b) Concept of ether

(c) Poynting vector

(d) Displacement current

★ ★ ★