Roll No. | | | | | | | | | | | | Total No. of Pages : 02

Total No. of Questions : 09

B.Tech.(Automation & Robotics/Civil Engg./CSE/EEE/EE/ECE/Electronics & Electrical Engg.) (Sem.-1,2)

OPTICS & MODERN PHYSICS

Subject Code : BTPH-102-18

M.Code : 75354

Date of Examination : 11-07-22

Time : 3 Hrs. Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1. SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.
2. SECTION - B & C have FOUR questions each.
3. Attempt any FIVE questions from SECTION B & C carrying EIGHT marks each.
4. Select atleast TWO questions from SECTION - B & C.

SECTION-A

1. Write Briefly :

a) A body of mass 0.02 kg execute simple harmonic motion with amplitude 2×10^{-2} m and time 2 period seconds. Calculate the total energy of the system.

b) Distinguish between the progressive waves and stationary waves.

c) What happens to the resolving power when the number of lines on a grating is decreased?

d) Differentiate between spontaneous and stimulated emission.

e) Two waves of same frequency with amplitudes 1.0 and 2.0 units, interfere at a point, where the phase difference is 30°. Find is the resultant amplitude.

f) Refractive index of water is 1.33. Calculate the angle of polarization for the light reflected from the surface of pond.

g) What do you understand by the wave-particle duality of matter waves?

h) Calculate the de Broglie wavelength associated with an electron subjected to a potential difference of 1.5kV.

i) Distinguish between p-and n-type semiconductors.

j) Give the physical significance of the density of states in 3-dimensions.

SECTION-B

2. a) What do understand by the simple harmonic motion. Find out the expression for the time period for a simple pendulum.

   b) A simple pendulum makes 180 complete oscillations in 3.0 min at a location where $g = 9.8 m/s^2$. Find the time period of oscillation and length of the pendulum.

3. Derive and explain the reflection and transmission coefficients for a longitudinal wave at boundaries.

4. a) With an appropriate diagram, explain the working of a Michelson's interferometer. Discuss briefly the method to find the wavelength of light incident.

   b) In Michelson's interferometer a thin plate is introduced in the path of one of the beams and it is found that 60 band crosses the line of observation. If the wavelength of light used is 5896A and $\mu = 1.4$, determine the thickness of plate.

5. a) Discuss the various components of a laser.

   b) Describe the construction and working of a He-Ne laser with necessary energy level diagram.

SECTION-C

6. a) What are matter waves and de-Broglie hypothesis? Explain the physical significance of Davission and Germer experiment.

   b) A hydrogen atom is 0.54Å in radius. Use uncertainty principle to estimate the minimum energy an electron can have in this atom.

7. Derive an expression for the time independent and dependent form of Schrodinger equation for a wave function.

8. Explain the salient features of quantum free-electron theory. Discuss the Kronig-Penny model for the motion of an electron in a periodic potential.

9. a) Explain the terms: drift velocity, relaxation time, and electrical conductivity. Derive the expression for the electrical conductivity.

   b) Find the relaxation time of conduction electron in a metal of resistivity $1.6 \times 10^{-8}\ \Omega^{-}m$, if the metal has 6.4×10^{28} conduction electrons/m^3.

NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.