

SECTION-B

- Q11. a) Explain free vibrations, damped vibrations, forced vibrations and resonance, giving one example of each. 3
- b) Discuss the theory of forced harmonic oscillations. How does sharpness of resonance depend on damping? 5
- Q12. a) Derive the equation for transverse waves on a string and discuss reflection and transmission of such waves at a boundary. 4
- b) Derive the equation for longitudinal waves on a string and discuss reflection and transmission of such waves at a boundary. 4
- Q13. a) Derive the expressions for reflectance and transmittance when an EM plane wave is incident normal at an interface. 5
- b) Define these: Fresnel's equations, Brewster's angle and total internal reflection. 3
- Q14. a) Explain the construction, working and energy diagram of Ruby laser. 5
- b) Make a comparison between solid state lasers and gas lasers in terms of their advantages and limitations. 3

SECTION-C

- Q15. Using Uncertainty principle, prove the :
- a) Non-existence of electron in the nucleus 4
- b) Radius of Bohr's first orbit 4
- Q16. a) Solve time-independent Schrodinger wave equation for a linear harmonic oscillator to derive expressions for its eigen functions and eigen-energy values. 5
- b) Normalise the wave function 3

$$\Psi(x) = 0 \text{ outside the box of size } l$$

$$\Psi(x) = A \sin kx \text{ for } 0 < x < l$$

$$\text{Where } k = \pi/l$$

- Q17. a) Using Bloch's theorem write the solutions for a wave function in a periodic potential. 6
- b) Write the limitations of free electron theory of metals. 2
- Q18. a) Distinguish between metals, semiconductors and insulators on the basis of their energy band diagrams. 3
- b) Differentiate between intrinsic and extrinsic semiconductors. 2
- c) Discuss the dependence of Fermi level on carrier-concentration and temperature. 3

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