ALVA'S INSTITUTE OF ENGINEERING AND TECHNOLOGY

Shobhavana Campus, Mijar- Moodbidri

I Internal Assessment Test Paper- March -2017

II Semester B.E. **Engineering Physics**

Time: 1.30 Hr | Max. Marks 30

Note: 1.Answer the following

2. **Physical Constants:** Electron mass (m) = 9.11×10^{-31} kg, Electron charge (e) = 1.6×10^{-19} C
Planck's constant (h) = 6.63×10^{-34} Js, Velocity of light (c) = 3×10^{8} m/s.
Avagadro number, $N_A = 6.02 \times 10^{26}$/K mole

PART-A

1. Obtain the relation between group velocity and phase velocity 5

OR

2. What are the postulates Planck's of quantum theory of radiation? Show Rayleigh –Jeans law can be derived from Planck's law of radiation 5

3. Show that electron does not exist inside the nucleus of an atom. 5

OR

4. Set up one dimensional Schrodinger's wave equation. 5

5. Discuss the eigen values and probability densities for particle in one dimensional potential well of infinite height for ground state and first two excited states. 5

OR

6. Compare the energy of a photon with that of a neutron when both are associated with wavelength 1Å, given that the mass of neutron is 1.678×10^{-27}kg. 5

PART- B

7. Explain (i) Stimulated absorption (ii) Stimulated emission (iii)Spontaneous emission (iv)Metastable state (v) Population inversion 5

OR

8. Describe the construction and working of semiconductor laser 5

9. Describe the construction and reconstruction processes in holography, with the help of suitable diagrams. 5

OR

10. Explain construction and working of CO_2 laser with suitable energy level diagram. 5

11. Obtain an expression for energy density of radiation under equilibrium condition in terms of Einstein's coefficients. 5

OR

12. A pulsed laser emits photons of wavelength 780nm with 20mW average power/pulse. Calculate the number of photons contained in each pulse if the pulse duration is 10nS 5

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QP setting

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Scheme of evaluation I IA test

March - 2017

Part - A

1. $v_g = \frac{d\omega}{dk}$, $v_p = \frac{\omega}{k}$ — (1)

Sub. for ω in v_g — (1)

Eq up to $v_g = v_p - \lambda \frac{dv_p}{d\lambda}$ — (3)

2. Postulates — (2)

Planck's law — (1)

Deduction of R-J law — (2)

3. $\Delta x \cdot \Delta p \geq \frac{h}{4\pi}$ — (1)

$\Delta p \leq 5.27 \times 10^{-21}$ — (1)

Up to $E^2 = p^2c^2 + m_0^2c^4$ — (2)

$E = 9.79$ MeV & interpretation — (1)

4. $\psi = \psi_0 e^{i(kx - \omega t)}$ — (1)

Up to $\frac{d^2\psi}{dx^2} = -k^2\psi$ — (1)

Up to $\frac{1}{\lambda^2} = -\frac{1}{4\pi^2\psi}\frac{d^2\psi}{dx^2}$ — (1)

Up to $K.E = \frac{-h^2}{8\pi^2 m}\frac{1}{\psi}\frac{d^2\psi}{dx^2}$ — (1)

Up to $\frac{d^2\psi}{dx^2} + \frac{8\pi^2 m(E-V)\psi}{h^2}$ — (1).

5. $E_n = \frac{n^2h^2}{8ma^2}$, $\psi_n = \sqrt{\frac{2}{a}} \sin\frac{n\pi x}{a}$ — (1)

eigen value direction for $n = 1, 2, 3$ — (3) marks

Graph — 1 mark.

$E = \frac{hc}{\lambda}$

$\lambda = \frac{h}{\sqrt{2mE}}$ } —(1)

$E_1 = \frac{hc}{\lambda_1}$ —(1)

$E_2 = \frac{h^2}{2m\lambda^2}$ —(1).

$\frac{E_1}{E_2}$ —(1)

$\frac{E_1}{E_2} = 1.5 \times 10^5$ —(1)

(7) @ 1 mark each for each definition

(8) Diagram —(1)
Energy level diagram —(1)
Construction —(1)
Working —(2)

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(9) Hologram construction diagram —(1)
" Reconstruction " —(1)
Construction expln —1½
Reconstruction expln —1½

Verified. Rajeshwari

(10) Diagram —(1)
Energy level diagram —(1)
Construction & working expln —(3)

(11) Rate of absorption = Rate of sp. emission + Rate of stimulated emission —(1)

Up to $U_\nu = \frac{A_{21}}{B_{21}} \left[\frac{1}{\frac{B_{12}}{B_{21}}\frac{N_1}{N_2} - 1} \right]$ —(1)

$\frac{N_1}{N_2} = e^{h\nu/kT}$ —(1) & $U_\nu = \frac{A_{21}}{B_{21}} \left[\frac{1}{\frac{B_{12}}{B_{21}} e^{h\nu/kT} - 1} \right]$ —(1)

Planck's law —(1), $\frac{A_{21}}{B_{21}} = \frac{8\pi h\nu^3}{c^3}$, $\frac{B_{12}}{B_{21}} = 1$ —(1)

(12) $\Delta E = \frac{hc}{\lambda} = 3.5 \times 10^{-19}$ —1½ $N = \frac{E}{\Delta t} = 7.86 \times 10^6$ —(2)

$E_{opt} = 2 \times 10^{-19}$ J —1½