



END SEMESTER ASSESSMENT (ESA Backlog) B. TECH. I/II SEMESTER Dec 2020

UE15/16//PH101: ENGINEERING PHYSICS

Time: 3 hours

Answer all questions

Max marks: 100

$$| m_e = 9.1 \times 10^{-31} \text{ kg} \quad | \quad h = 6.63 \times 10^{-34} \text{ Js} \quad | \quad k_B = 1.38 \times 10^{-23} \text{ JK}^{-1} \quad |$$

$$| c = 3 \times 10^8 \text{ ms}^{-1} \quad | \quad N_A = 6.02 \times 10^{23} \text{ per mol} \quad |$$

1.	a)	Discuss the dual nature of radiation and matter listing the experiments involved.	5
	b)	Show that protons can exist in a nucleus using the Uncertainty principle.	5
	c)	Derive a relation between phase and group velocities.	4
	d)	What is the physical meaning of a quantum wavefunction? List a few quantum wavefunctions.	6
2.	a)	What are Eigen values and Eigen functions? What is the use of an Eigen value equation?	5
	b)	Write the solutions for a Barrier potential in all the three regions.	5
	c)	Find the energies and wavefunctions for an electron confined in a one-dimensional infinite well of length 10 angstrom.	6
	d)	Compare the eigen functions of a particle in a 1D finite well and 1D infinite well of same width.	4
3.	a)	Discuss the successful results of the classical (Drude model) free electron theory.	5
	b)	Show that the probability of occupation of a state δE above the Fermi energy is equal to the probability of non-occupation of a state δE below the Fermi level.	4

3.	c)	Derive an expression for density of states.	7
	d)	Define Fermi speed and Fermi temperature.	4
4.	a)	Derive an expression for the energy density using Einstein's coefficients.	6
	b)	What is population inversion? How is it achieved in lasers?	4
	c)	Find the wavelength of a semiconductor laser with a band gap of 4.09 eV	4
	d)	Explain using an energy level diagram the working of a gas/solid state laser.	6
5.	a)	What is Larmor frequency? Evaluate the Larmor angular frequency in a magnetic field of 10 tesla.	3
	b)	Discuss the classification of magnetic materials based on the temperature dependence of susceptibility	5
	c)	Derive an expression for polarization of a dielectric in an external electric field E. Calculate the susceptibility and the polarization developed in a dielectric when an electric field of 200 V/m is applied and if the dielectric constant is 45.	6
	d)	Discuss the phase transitions of Barium Titanate and explain the concept of Curie temperature.	6

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