SRN												

PES University, Bengaluru
(Established under Karnataka Act 16 of 2013)

UE17/18/19
PH101

END SEMESTER ASSESSMENT (ESA) B. TECH. I SEMESTER DECEMBER 2020

UE17/18/19PH101: ENGINEERING PHYSICS

Time: 3 hours **Answer all questions** **Max marks: 100**

$| m_e = 9.1x10^{-31}\,kg \;|\; h = 6.63x10^{-34}Js \;|\; k_B = 1.38 \times 10^{-23}\,JK^{-1} |$

$| c = 3x10^8\,ms^{-1} \;|\; N_A = 6.02x10^{23}\ per\ mol \;|$

1.	a)	Using Maxwell's equations show that **E(z)** and **B(z)** are orthogonal.	5
	b)	Discuss how Compton showed the particle nature of waves.	5
	c)	Derive a relation between phase and group velocities.	4
	d)	Using Gamma ray microscope thought experiment derive the uncertainty principle.	6
2.	a)	Discuss the properties of quantum wave functions. Define normalization.	5
	b)	Discuss the nature of wavefunctions for a particle in a finite well and compare them with the case for an infinite well	5
	c)	Determine the normalization constant for a particle with a wavefunction $\Psi = C\cos\left(\frac{n\pi x}{a}\right)$ for the limits $x = 0$ *to* $x = a$ and calculate the probability of locating the particle in the first half of the well in the ground state.	7
	d)	Explain the terms zero-point energy for a quantum harmonic oscillator.	3
3.	a)	Discuss any three successful results of the quantum free electron theory.	6
	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)	What are Fermions? Discuss the distribution of Fermions in the energy states when they are restricted to move in a cube of side ***d***.	6
	d)	Find the electron density in a metal with a Fermi energy of 5.5 eV.	4
4.	a)	Derive an expression connecting Einstein's coefficients to the energy density.	6
	b)	What is population inversion? How is it achieved?	4
	c)	Discuss the concept of round-trip gain and derive an expression for threshold gain.	6
	d)	Discuss the important concepts of a heterojunction laser.	4
5.	a)	Evaluate the Larmor angular frequency in a magnetic field of 8 tesla.	3
	b)	What is a phase transition? Give an example of a magnetic phase transition.	5
	c)	Derive an expression for polarization of a dielectric in an external electric field E.	6
	d)	Discuss the phase transitions of Barium Titanate and explain the concept of Curie temperature.	6

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