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PES University, Bengaluru

(Established under Karnataka Act 16 of 2013) **UE20PH101**

END SEMESTER ASSESSMENT (ESA) B. TECH. I SEMESTER APRIL 2021

UE20PH101 ENGINEERING PHYSICS

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

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

$| \ \mathbf{e = 1.6\ x\ 10^{-19}\ C} \ | \ \mathbf{N_A = 6.02x10^{23}\ per\ mol} \ | \ \mathbf{m_p = 1.67\ x\ 10^{-27} kg} \ |$

1.	**a)**	Draw a plot of the black body spectrum, list your observations and explain how a theoretical model could fit the curves.	**5**
	b)	What is group velocity? Show that it represents particle velocity.	**5**
	c)	Discuss the properties and significance of Ψ and $\|\Psi\|^2$.	**5**
	d)	What is the Uncertainty principle? An electron's speed is measured to be 2340 $m\ s^{-1}$ with an uncertainty of 1 $cm\ s^{-1}$. Calculate the uncertainty in its position.	**5**
2.	**a)**	What is an Eigen value equation? What is its significance in quantum mechanics? Explain with an example.	**5**
	b)	How do the Eigen wavefunctions of a particle bound in a finite well compare with those of an infinite well? Demonstrate with graphs.	**4**
	c)	Solve the Schrodinger's equation for particles $(E > V_0)$ incident on a **step potential** of height V_0 and show that $R + T = 1$.	**8**
	d)	Give the expression of the potential used in the Hydrogen atom model. Write the first three Eigen energy values.	**3**
3.	**a)**	What is drift velocity? Derive an expression for the microscopic form of the Ohm's law.	**4**
	b)	Derive an expression for the Density of States in metals.	**6**
	c)	What is Fermi factor? Find the temperature at which there is a probability of occupation of	**5**

		0.1 at a state 0.2 eV above the Fermi level.	
	d)	Plot a labelled periodic potential used in the Kronig-Penney model and define the Bloch function.	**5**
4.	**a)**	Discuss the requirements of a laser system.	**4**
	b)	Discuss 3 and 4 level laser systems with examples.	**6**
	c)	Give the details of the following for each of $\boldsymbol{HeNe}$, $\boldsymbol{CO_2}$ $\boldsymbol{and\ Semiconductor\ lasers}$. 1. Pumping mechanism 2. Active medium 3. Laser wavelength 4. Power of the emitted laser	**8**
	d)	Write a note on Holography.	**2**
5.	**a)**	Classify magnetic materials based on the temperature dependence of susceptibility using plots.	**6**
	b)	What is Larmor precession? Calculate the Larmor angular frequency for **protons** in a field of strength 10 T.	**4**
	c)	Discuss the origins of electric polarization.	**4**
	d)	Briefly discuss the phenomena of piezoelectricity, pyroelectricity and ferroelectricity and their inter-relation.	**6**

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