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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**

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

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

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| **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 $\Psi$ 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** |

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| | **c)** | What is Fermi factor? Find the temperature at which there is a probability of occupation of 0.1 at a state 0.2 eV above the Fermi level. | **5** |
| | **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 $\boldsymbol{HeNe}$, $\boldsymbol{CO_2}$ $\boldsymbol{and\ Semiconductor\ lasers}$.<br>1. Pumping mechanism<br>2. Active medium<br>3. Laser wavelength<br>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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