USN										

FIRST Semester B. E. Degree Semester End Examination (SEE), Jan/ Feb 2024

Physics of Condensed Matter

(Model Question Paper - 1)

[Time: 3 Hours] [Maximum Marks: 100]

Instructions to students:
i. Answer FIVE FULL Questions as per choice.
ii. Use BLACK ball point pen for text, figure, table, etc.
iii. Assume missing data, if any.

	Module-1	Marks	CO	RBT Level
1. a)	Define wave function then Setup the time-independent one-dimensional Schrödinger's wave equation	**[08 Marks]**	**CO1**	**L2**
b)	Deduce Wein's law and Rayleigh Jean's law from Plank's law of radiation	**[07 Marks]**	**CO1**	**L2**
c)	In a measurement of position and momentum that involved an uncertainty of 0.003 %, the speed of an electron was found to be 800m/s. Calculate the corresponding uncertainty that arises in determining its position.	**[05 Marks]**	**CO1**	**L3**
	OR			
2. a)	Derive an expression for Eigen function and Eigen energy value equation for particle in a one -dimensional infinite potential well	**[08 Marks]**	**CO1**	**L3**
b)	b) State Heisenberg's uncertainty principle and show that a free electron cannot exist within the nucleus of an atom.	**[07 Marks]**	**CO1**	**L2**
c)	c) Calculate the momentum of the particle and de Broglie wavelength associated with an electron with a kinetic energy of 1.5 eV.	**[05 Marks]**	**CO1**	**L2**
	Module-2			
3. a)	What is Fermi factor and explain the variation of Fermi factor with respect to temperature and energy.	**[08 Marks]**	**CO2**	**L2**
b)	Mention the expression of hole and electron concentration in a intrinsic semiconductor and derive the expression for Electrical conductivity of a semiconductor.	**[07 Marks]**	**CO2**	**L2**
c)	The Hall coefficient of a material is -3.68×10^{-5} m^3/C. What is the type of charge carriers? Also calculate the carrier concentration.	**[05 Marks]**	**CO2**	**L2**
	OR			
4. a)	What is hall effect? Obtain the expression for hall coefficient and express hall voltage in terms of Hall coefficient	**[08 Marks]**	**CO2**	**L2**
b)	Describe the successes of quantum free electron theory.	**[07 Marks]**	**CO2**	**L1**

	c)	Calculate the probability of an electron occupying an energy level 0.02eV above the Fermi level at 200k and 400k.	**[05 Marks]**	**CO2**	**L3**

Module-3

5.	a)	Define spontaneous emission and stimulated emission. Derive the expression for energy density of radiation at equilibrium in terms of Einstein's coefficients.	**[08 Marks]**	**CO3**	**L2**
	b)	Describe different types of optical fibers with neat diagrams	**[07 Marks]**	**CO3**	**L1**
	c)	Find the attenuation in an optical fiber of length 500m when alight signal of power 100mW emerges out of the fiber with a power of 90mW.	**[05 Marks]**	**CO3**	**L3**

OR

6.	a)	Define numerical aperture and derive the expression for numerical aperture of an optical fiber and mention the condition for ray propagation in optical fiber.	**[08 Marks]**	**CO3**	**L3**
	b)	Explain the construction and working of a semiconductor Laser	**[07 Marks]**	**CO3**	**L2**
	c)	The average output power of laser source emitting a laser beam of wavelength 632.8nm. Find the number of photons emitted per second by the laser source	**[05 Marks]**	**CO3**	**L3**

Module-4

7.	a)	State and explain Gauss divergence theorem and Mention the Stoke's theorem.	**[08 Marks]**	**CO2**	**L3**
	b)	What is displacement current, derive the expression for displacement current.	**[07 Marks]**	**CO2**	**L3**
	c)	The dielectric constant of He gas at N.T.P. is 1.0000684. Calculate the electronic polarizability of the gas containing 2.7×10^{25} atoms/m^3.	**[05 Marks]**	**CO2**	**L3**

OR

8.	a)	Derive wave equation in terms of electric field using Maxwell's equation for free space.	**[08 Marks]**	**CO2**	**L3**
	b)	Define Internal field and derive Clausius – mossotti relation.	**[07 Marks]**	**CO2**	**L1**
	c)	Find constant C, such that $\vec{A} = (x+ay)\hat{a}_x + (y+bz)\,\hat{a}_y + (x+cz)\hat{a}_z$ is solenoid	**[05 Marks]**	**CO2**	**L2**

Module-5

9.	a)	Explain construction and working of SEM	**[08 Marks]**	**CO4**	**L2**
	b)	Mention any three properties and any four applications of carbon nano tubes.	**[07 Marks]**	**CO4**	**L3**
	c)	Explain experimental determination of responsivity of photodiode.	**[05 Marks]**	**CO5**	**L2**

OR

10.	a)	Explain construction and working of TEM	**[08 Marks]**	**CO4**	**L2**
	b)	Describe the synthesis of carbon nanotubes by Arc discharge method	**[07 Marks]**	**CO4**	**L2**

c) In an optical fibre experiment the Laser light propagating through optical fibre cable of 1.5m, made a spot diameter of 8mm on the screen. The distance between the end of the optical fibre cable and the screen is 0.031 m. calculate angle of contact and numerical aperture of given optical fibre? **[05 Marks] CO5 L3**

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