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NMAM INSTITUTE OF TECHNOLOGY, NITTE

(An Autonomous Institution affiliated to VTU, Belagavi)

First Semester B.E. (Credit System) Degree Examinations

Make up Examinations - July - August 2021

20PH102 – ENGINEERING PHYSICS

Duration: 3 Hours

Max. Marks: 100

List of constants: Velocity of light, $c = 3 \times 10^8\ ms^{-1}$, Planck's constant, $h = 6.63 \times 10^{-34}$ Js,
Electron mass, $m=9.11\times10^{-31}$ kg, Electron charge, $e=1.6\times10^{-19}$ C,
Permittivity of vacuum, $\varepsilon_o = 8.85\times10^{-12}$F/m, Boltzmann constant, $k=1.38\times10^{-23}$ J/K,
Avogadro number, $N_A = 6.023\times 10^{26}$ / kgmole, Neutron mass $m=1.678 \times 10^{-27}$ kg

Note: Answer ***Five full*** *questions choosing* ***One full*** *question from* ***each Unit.***

		Unit – I	Marks	BT*	CO*	PO*
1.	a)	What are matter waves? Mention their properties.	6	L*2	1	1,2
	b)	Obtain the time independent Schrodinger wave equation for a particle in one dimensional potential well of infinite height and discuss about energy eigen values.	10	L2	1	1,2
	c)	An electron is bound in a one dimensional potential well of width 1Å, but of infinite wall height. Find its energy values in the ground state and also in the first two excited states.	4	L3	1	1,2
	a)	Derive an expression for group velocity on the basis of superposition of two travelling waves.	6	L2	1	1,2
	b)	Derive the time independent Schrodinger wave equation.	10	L2	1	1,2
	c)	Compare the momentum, and the kinetic energy of an electron with de Broglie wavelength of 1Å, with that of a photon with same wavelength.	4	L3	1	1,2
		Unit – II				
	a)	Explain the seven crystal systems with neat diagrams.	6	L1	2	1,2
	b)	Describe the procedure to determine the Miller indices of crystal planes. Derive an expression for inter - planar spacing of a crystal.	10	L2	2	1,2
	c)	Calculate the glancing angle of incidence of x-rays of wavelength of 0.58Å on the plane (1 3 2) of NaCl, which results in second order diffraction maxima taking the lattice spacing as 3.81Å.	4	L3	2	1,2
	a)	Explain the origin of continuous and characteristic x-ray spectrum.	6	L2	2	1,2
	b)	Define packing factor and coordination number. Calculate the coordination number and packing factor for bcc and fcc structures.	10	L2	4	1,2
	c)	Nickel has fcc structure with lattice constant 3.52Å. Calculate the inter-planar spacing for (a) (101) planes, and (b) (123) planes.	4	L3	2	1,2
		Unit – III				
	a)	Mention the assumptions and limitation of free electron theory.	6	L2	3	1,2
	b)	What are relaxation time and collision time? On the basis of free electron theory of metals, obtain an expression for the electric conductivity of the metal.	10	L2	3	1,2
	c)	Estimate the relaxation time of conduction electrons in silver from following data: Resistivity = 1.6×10^{-8} ohm. m Density = 10.5×10^{-3} kg/m^3, Atomic weight = 107.88.	4	L3	3	1,2

P.T.O.

6.	a)	Distinguish between Type I and Type II superconductors.	6	L2	4
	b)	Discuss briefly the BCS theory of superconductivity. Explain any two applications of superconductivity.	10	L2	3
	c)	Superconducting tin has a critical magnetic field of 217 gauss at 2 K. If the critical temperature for superconducting transition for tin is 3.7 K, find the critical, magnetic field at 3K.	4	L3	3

Unit – IV

7.	a)	Describe an extrinsic and intrinsic semiconductor with neat diagram.	6	L2	4
	b)	Define Fermi energy. Sketch the Fermi level in (i) intrinsic semiconductor (ii) n-type semiconductor and (iii) p-type semiconductor. Discurr the effect of temperature on Fermi level in intrinsic and n-type Semiconductor.	10	L3	4
	c)	The Hall co-efficient of a specimen of a doped silicon is found to be $3.66 \times 10^{-4} m^3$/Coulomb. The resistivity of the specimen is 8.93×10^{-3} ohm. m. Find the mobility and density of the charge carrier, assuming single carrier conduction.	4	L3	4
8.	a)	Explain the construction and working of a LED with neat diagrams.	6	L2	4
	b)	Describe the formation of p-n junction. Explain its voltage current characteristics. What is the effect of temperature on conductivity of Intrinsic semiconductors?	10	L1	4
	c)	Calculate the barrier potential existing at the junction of p-type silicon with an acceptor concentration of $10^{23} m^{-3}$ and n-type silicon with a donor concentration of $10^{20} m^{-3}$ if the intrinsic concentration at 300k is $1.4 \times 10^{16} m^{-3}$.	4	L3	4

Unit – V

9.	a)	Describe the construction and working of a He-Ne laser.	6	L2	5
	b)	Describe the attenuation in the optical fiber. What are the advantages of optical communications over other conventional types of communication?	10	L3	5
	c)	The ratio of the population of two energy levels is 1.059×10^{-30}. Find the wavelength of light emitted at 300K.	4	L1	5
10.	a)	Explain the terms with neat energy level diagram. i) population inversion, ii) metastable state and iii) stimulated emission.	6	L2	5
	b)	Describe the types of optical fibers and modes of transmission with suitable diagrams.	10	L4	5
	c)	A step index optical fiber 63.5 μm in core-diameter has a core of refractive index 1.53 and a cladding of index 1.39. Determine (i) the numerical aperture of the fiber and (ii) the critical angle for core-cladding interface.	4	L1	5

BT* Bloom's Taxonomy, L* Level; CO* Course Outcome; PO* Program Outcome

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First / Second Semester B.E. (Credit System) Degree Examinations

Make up/Supplementary Examinations – September 2021

20PH102 – ENGINEERING PHYSICS

Duration: 3 Hours

Max. Marks: 100

List of constants: Velocity of light, $c = 3\times10^{8}\ ms^{-1}$, Planck's constant, $h = 6.63\times10^{-34}$ Js, Electron mass, $m = 9.11\times10^{-31}$kg, Electron charge, $e = 1.602\times10^{-19}$C, Boltzmann constant, $k=1.38\times10^{-23}$J/K. Avogadro number, $N_A = 6.023 \times 10^{26}$/ kg mole.

Note: Answer any ***Five full*** *questions.*

			Marks	BT*	CO*	PO*
1.	a)	What are matter waves? Derive an expression for de Broglie wavelength of an electron of mass m, accelerated by a potential of V volts.	6	L*2	1	1, 2
	b)	Derive Schrodinger's time independent one-dimensional wave equation for a particle of mass m with energy E.	10	L3	1	1, 2
	c)	An electron is trapped in a one-dimensional region of length 1.2Å. Calculate the energy required to excite the electron from the ground state to the first excited state?	4	L3	1	1, 2
2.	a)	Explain: (i) Heisenberg's uncertainty principle, (ii) Probability density and (iii) Normalization of a wave function.	6	L1	1	1, 2
	b)	What are Eigen values and Eigen functions? Discuss the wave function, probability density and energy Eigen values for a particle in an infinite potential well by considering its ground state and the first two excited states.	10	L3	1	1, 2
	c)	Calculate the momentum and de Broglie wavelength associated with an electron subjected to a potential difference of 1.5 kV.	4	L3	1	1, 2
3.	a)	What are Miller Indices? Explain how the axial intercepts in a crystal plane are converted to Miller indices.	6	L2	2	1, 2
	b)	Define Coordination number and Atomic packing factor. Calculate the atomic packing factor for base centered cubic (BCC) and face centered cubic (FCC) lattices by calculating number of atoms/unit cell and the relation between atomic radius and lattice constant.	10	L2, L3	2	1, 2
	c)	Calculate the glancing angle for incidence of X-rays of wavelength 0.58 Å on the plane (132) of NaCl which results in 2nd order diffraction maxima taking the lattice constant as 3.81 Å.	4	L3	2	1, 2
4.	a)	What are X-rays? With the neat diagram of an X-ray tube explain the production of X-rays.	6	L2	2	1, 2
	b)	Derive Bragg's law for the X-ray diffraction by crystal planes. Explain in detail the construction and working of Bragg's X-ray spectrometer.	10	L3	2	1, 2
	c)	Iron crystallizes in BCC structure. Calculate the lattice constant. Given that, the atomic weight of iron is 55.85 and density of iron is 7860 kg/m³.	4	L3	2	1, 2

P.T.O.

5.	a)	Mention the assumptions and limitation of classical free electron theory.	6	L1	3
	b)	Obtain an expression for the electrical conductivity of a metal based on classical free electron theory.	10	L3	3
	c)	Superconducting tin has a critical magnetic field of 217 gauss at 2 K. If the critical temperature for superconducting transition for tin is 3.7 K. Find the critical magnetic field at 3 K.	4	L3	3
6.	a)	Define Matthiessen's rule and explain the effect of temperature on electrical resistivity of metals.	6	L2	3
	b)	Discuss critical magnetic field and Meissner effect in superconductors. Distinguish between Type-I and Type-II superconductors.	10	L3	3
	c)	Find the temperature at which there is 2% probability that an energy level 0.3 eV above Fermi energy level is occupied.	4	L3	3
7.	a)	What are direct and indirect band-gap semiconductors? Explain.	6	L2	4
	b)	What are intrinsic semiconductors? Obtain an expression for the conductivity of an intrinsic semiconductor. Explain the effect of temperature on the resistivity of an intrinsic semiconductor.	10	L3	4
	c)	An n-type semiconductor has a Hall coefficient of 3.66×10^{-4} m^3/C and its resistivity is found to be 2.12 ohm-m. Calculate charge carrier concentration and electron mobility at room temperature.	4	L3	4
8.	a)	Distinguish between avalanche diode and Zener diode.	6	L2	4
	b)	Explain Hall Effect. Obtain an expression for the Hall coefficient and carrier concentration of an n-type semiconductor. Mention any four applications of Hall effect.	10	L3	4
	c)	Mobilities of electrons and holes in a sample of intrinsic germanium at 300K are 0.36 $m^2V^{-1}s^{-1}$ and 0.17 $m^2V^{-1}s^{-1}$ respectively. If the resistivity of the specimen is 2.12 Ωm, compute the intrinsic carrier density.	4	L3	4
9.	a)	Derive an expression for numerical aperture of an optical fiber in terms of refractive index of core and cladding.	6	L2	5
	b)	What is a laser? Describe the construction and working of a He-Ne laser with necessary energy level diagram.	10	L3	5
	c)	The core refractive index of the optical fiber is 1.40, its relative refractive index is 2.5%. Determine the numerical aperture and the critical angle.	4	L3	5
10.	a)	Explain the basic components required for the construction of a laser?	6	L2	5
	b)	Give general description of an optical fiber with the working principle. Explain in brief different attenuation mechanisms in an optical fiber.	10	L3	5
	c)	Find the ratio of population of the two energy states, the transition between which emits photons of wavelength 694.3 nm, at 27°C.	4	L3	5

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