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NMAM INSTITUTE OF TECHNOLOGY, NITTE

(An Autonomous Institution affiliated to VTU, Belagavi)

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

April -- May 2018

17PH102 – ENGINEERING PHYSICS

Duration: 3 Hours

Max. Marks: 100

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

List of constants: Velocity of light, $c=3x10^8 ms^{-1}$. Planck's constant, $h=6.63x10^{-34}$ Js, Electron mass, $m=9.11x10^{-31}$kg, Electron charge, $e=1.6x10^{-19}$C, Permittivity of vacuum, $\varepsilon_o = 8.85x10^{-12}$ F/m, Boltzmann constant, $k=1.38x10^{-23}$J/K. Permeability of free space, $\mu_0 = 1.26x10^{-6}$ Wb/Am Avogadro number $N_A=6.023x10^{26}$/kmol

Unit – I

		Marks	BT*
1. a)	What is a wave function? Mention any four characteristics.	6	L*2
b)	Derive Schrodinger's time independent wave equation in one dimension for a particle of mass m with energy E.	10	L2
c)	Calculate the wavelength associated with an electron subjected to a potential difference of 1.25 kV.	4	L3
2. a)	What are matter waves? Mention their characteristics.	6	L2
b)	Solve Schrodinger's wave equation for a particle in an infinitely deep potential well of width L and show that the energy values are quantized.	10	L3
c)	An electron is bound in a one dimensional potential well of width 4 Å of infinite wall height. Find its first three energy values	4	L3

Unit – II

a)	What is a unit cell? How many and which parameters are needed to define a unit cell? Draw any two unit cell with lattice parameters.	6	L2
b)	Define primitive & non primitive unit cell, Miller indices and inter planar distance. Derive an expression for inter planar distance in terms of Miller indices for the case of a cubic crystal.	10	L2
c)	The inter planar distance of (110) planes is 2Å for a FCC crystal. Find out the atomic radius.	4	L3
a)	What are x-rays? Explain the origin of characteristics x-rays with necessary diagrams.	6	L2
b)	Define coordination number & atomic packing factor? Determine the atomic packing factor for face centered cubic (FCC) by calculating number of atoms per unit cell and obtaining relation between lattice constant & atomic radius.	10	L3
c)	Iron crystallizes is BCC structure. Calculate the lattice constant given that, the atomic weight of iron is 55.85 and density of iron is 7860 kg/m^3.	4	L3

Unit – III

a)	Explain i) drift velocity ii) mean free path iv) mean collision time and v) relaxation time	6	L2
b)	What are the basic assumptions of the classical free electron theory? Obtain an expression for the electrical conductivity of a metal based on classical free electron theory.	10	L3
c)	Calculate the probability of an electron occupying an energy level 0.02 eV above Fermi level at 200 K.	4	L3

P.T.O.

6. a) Explain Fermi energy and Fermi factor. Discuss the dependence of Fermi factor on temperature. 6
   b) What are intrinsic semiconductors? Obtain an expression for the conductivity of an intrinsic semiconductor. Explain the effect of temperature on the conductivity of an intrinsic semiconductor. 10
   c) The Hall co-efficient of a doped silicon is found to be 3.66×10^{-4} m^3/C. The resistivity of the specimen is 8.93×10^{-3} Ωm. Find the mobility and carrier concentration. 4

Unit – IV

7. a) Explain i) Absorption ii) stimulated emission iii) population inversion 6
   b) Explain the construction and working of a Ruby laser with neat energy level diagram. Mention its advantages and applications. 10
   c) The ratio of population of two energy levels is 1.059×10^{-30}. Find the wavelength of light emitted at 300k. 4

8. a) Define numerical aperture of an optical fiber. Derive an expression for numerical aperture with neat ray diagram 6
   b) Describe an optical fibre. Explain the different types of optical fibers with suitable diagrams. 10
   c) The refractive index of core and cladding of optical fiber are 1.50 and 1.48 respectively. Find the numerical aperture and acceptance angle when fiber kept in air medium. 4

Unit – V

9. a) What are ferro-magnetic materials? Mention their characteristic properties. 6
   b) What are nano materials? Explain in detail the preparation of nanomaterials using PVD. 10
   c) What are ultrasonic waves? What are its applications? Mention the methods of generation of ultrasonic waves. 4

10. a) What are ferro-electric materials? Mention their characteristic properties. 6
    b) What is superconductivity? Explain four characteristic properties of superconductors. Explain Type-I and Type-II superconductors. 10
    c) A magnetic field of 2000 A/m is applied to a material which has susceptibility of 1000. Calculate i) relative permeability and ii) intensity of magnetization. 4

BT* Bloom's Taxonomy, L* Level

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NMAM INSTITUTE OF TECHNOLOGY, NITTE

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

Make up / Supplementary Examinations – July 2018

17PH102 – ENGINEERING PHYSICS

ation: 3 Hours Max. Marks: 100

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

Velocity of light, c = 3 x 108ms-1, Planck's constant, h = 6.63 x 10^{-34} Js,
Electron mass, m=9.11x10^{-31}kg, Electron charge, e=1.6x10^{-19}C,
Permittivity of vacuum, εo = 8.85x10^{-12}/m, Boltzmann constant, k=1.38x10^{-23}/K
Avogadro number, NA = 6.023 x 10^{26}/k mole.
Permeability of free space, $\mu_0 = 1.26 \times 10^{-6}\ wb/Am$

		Marks	BT
	Unit – I		
a)	Define phase velocity and group velocity. Obtain a relation between these two.	6	L2
b)	Obtain the time independent Schrödinger wave equation for a particle in one dimensional potential well of infinite height and discuss about energy Eigen values.	10	L2
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	L4
a)	Derive an expression for group velocity on the basis of superposition of two travelling waves.	4	L4
b)	Derive the time independent Schrödinger wave equation.	10	L4
c)	Compare the momentum, the total energy, and the kinetic energy of an electron with de Broglie wavelength of 1Å, with that of a photon with same wavelength.	6	L4
	Unit – II		
a)	Explain the seven systems of crystals with neat diagrams.	6	L1
b)	Describe the construction and working of a Bragg's spectrometer and explain how it is used to for determination of inter-planar spacing in a crystal.	10	L4
c)	Compare the momentum, the total energy, and the kinetic energy of an electron with de Broglie wavelength of 1Å, with that of a photon with same wavelength.	4	L4
a)	Explain origin of continuous and characteristic x-ray spectrum.	6	L4
b)	Define packing factor. Calculate the coordination number and packing factor for fcc structures.	10	L5
c)	Nickel has fcc structure with lattice constant 3.52Å. Calculate the inter-planar spacing for (a) (101) planes, (b) (123) planes and (c) (320) planes.	4	L4
	Unit – III		
a)	Define drift velocity, relaxation time and mean free path and hence derive expression for drift velocity in the case of metal.	6	L4
b)	What is Hall effect? Explain how Hall field is generated in n-type semiconductor and obtain an expression for the Hall coefficient, Hall voltage and mobility of charge carriers.	10	L2
c)	The Fermi level in silver is 5.5 eV. What are the energies for which the probabilities of occupancy at 300K are 0.01.	4	L5

P.T.O.

6. a) Give the assumption of which the classical free electron theory is based. Explain the failure of classical free electron theory. 6

b) Define Fermi energy and Fermi factor. Discuss about the variation of Fermi factor with temperature and energy. Sketch the Fermi level in (a) intrinsic semiconductor (b) n-type semiconductor and (c) p-type semiconductor. 10

c) The Hall co-efficient of a specimen of a doped silicon is found to be 3.66×10^{-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

Unit – IV

7. a) Explain the terms i) population inversion, ii) metastable state and iii) stimulated emission. 6

b) Obtain an expression for the numerical aperture of the optical fiber. Describe single mode step index optical fiber. 10

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

8. a) What are lasers? Describe the construction and working of a Ruby laser. 6

b) Describe the attenuation in the optical fiber. What are the advantages of optical communications over other conventional types of communication? 10

c) The ratio of the population of two energy levels is 1.059×10^{-30}. Find the wavelength of light emitted at 300K. 4

Unit – V

9. a) What are ferroelectric materials? Explain the properties of ferroelectric materials. 6

b) Explain with principle, how the defect in a solid can be detected by a non-destructive method using ultrasonic waves. 10

c) A silicon material is subjected to a magnetic field of strength 1000A/m. If the magnetic susceptibility of silicon is -0.3×10^{-5}. Calculate its magnetization, also evaluate the magnetic flux density of the field inside the material. 4

10. a) Explain the types of superconductors. 6

b) Explain magnetic hysteresis on the basis of domain theory. Mention some applications of ferromagnetic materials. 10

c) What are nano materials? Mention its any three applications. 4

BT* Bloom's Taxonomy, L* Level

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NMAM INSTITUTE OF TECHNOLOGY, NITTE

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

November - December 2018

18PH102 – ENGINEERING PHYSICS

Duration: 3 Hours **Max. Marks:** 100

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

List of constants: Velocity of light, $c=3\times10^{8}ms^{-1}$, Planck's constant, $h=6.63\times10^{-34}$ Js, Electron mass, $m=0.11\times10^{-31}$kg, Electron charge, $e=1.6\times10^{-19}$C, Boltzmann constant, $k=1.38\times10^{-23}$J/K, Avogadro number, $N_A = 6.022 \times 10^{26}$/ kg mole.

			Marks	BT*	CO*	PO*
		Unit – I				
1.	a)	Define the terms i) Matter waves ii) Wave function iii) Free particle and iv) Eigen Value.	6	L1	1	1
	b)	Derive one dimensional Schrodinger's time independent wave equation.	10	L2	1	1,2
	c)	An electron beam is subjected to a potential of 10^3 volts. Find the de Broglie wavelength associated with the electron.	4	L3	1	1,2
2.	a)	Define phase velocity and group velocity. Obtain an expression for phase velocity.	6	L1,L2	1	1,2
	b)	Obtain the solution of Schrodinger's wave equation for a particle in one dimensional potential well of infinite height and finite width.	10	L2	1	1,2
	c)	An electron is trapped in a one dimensional region of length 1.5 Å. How much energy must be supplied to excite the electron from the ground level to the first excited state?	4	L3	1	1,2
		Unit – II				
3.	a)	Explain the terms i) unit cell ii) primitive unit cell and iii) non-primitive unit cell with necessary diagrams.	6	L2	2	1
	b)	Define inter planar distance. Derive the relation between inter planar distance and Miller indices of the planes of a cubic crystal.	10	L2	2	1,2
	c)	Copper has FCC structure of atomic radius 0.1278 nm. Calculate the inter planar distance for (3 2 1) plane.	4	L3	2	1,2
4.	a)	What are X-rays? Mention its properties and applications.	6	L1	2	1
	b)	What is atomic packing factor? Determine the atomic packing factor for the case of face centred cubic (FCC) lattice by calculating number of atoms/unit cell and obtaining relation between atomic radius and lattice constant.	10	L3	2	1,2
	c)	Calculate the glancing angle for incidence of X-rays of wavelength 0.58 Å on the plane (132) which results in 2nd order diffraction maxima taking the lattice spacing as 3.81 Å.	4	L3	2	1,2
		Unit – III				
5.	a)	What is a laser? Explain its characteristic properties.	6	L2	3	1
	b)	Describe the construction and working of a ruby laser with neat diagrams.	10	L2	3	1
	c)	Find the ratio of population of atoms in two energy states at 300 K, the transition between which emits a photon of wavelength of 590 nm.	4	L3	3	1,2

P.T.O.

6.	a)	Define numerical aperture. Obtain an expression for the numerical aperture.	6	L2	3	
	b)	Write a note on optical fiber. Explain three different types of optical fiber with neat schematic and ray diagram.	10	L2	3	
	c)	An optical fiber has a core material with refractive index 1.55 and its cladding material has a refractive index of 1.50. The light is launched from air. Calculate its numerical aperture and the acceptance angle.	4	L3	3	

Unit – IV

7.	a)	What is Matthiessen's rule? Explain in detail.	6	L2	4	
	b)	Assuming the electron-lattice interaction to be responsible for scattering of conduction electrons in metal, obtain an expression for the conductivity in terms of relaxation time.	10	L2	4	
	c)	A uniform silver wire has a resistivity of 1.54×10^{-8} Ωm at room temperature. For an electric field along the wire of 100 V/m, compute the drift velocity of an electron and the mobility assuming that there is 5.8×10^{28} conduction electrons/m^3.	4	L3	4	
8.	a)	Mention any three assumptions and three drawbacks of classical free electron theory.	6	L1	4	
	b)	Write a note on i) Type-I and Type-II superconductors and ii) BCS theory.	10	L2	4	
	c)	The critical temperature and critical field for superconducting lead are 7.2 K and 800 gauss respectively. What will be the temperature upto which lead will be in superconducting state in a magnetic field of 400 gauss?	4	L3	4	

Unit – V

9.	a)	What is intrinsic semiconductor? Explain carrier generation in intrinsic semiconductor.	6	L2	5	
	b)	What is Hall effect? Derive an expression for carrier concentration and Hall Coefficient.	10	L2	5	
	c)	The electron mobility and hole mobility of silicon are 0.17 $m^2/V.s$ and 0.035 $m^2/V.s$ respectively at room temperature. If the carrier density is known to be $1.1 \times 10^{16}/m^3$, calculate the resistivity of silicon.	4	L3	5	
10.	a)	Distinguish between zener breakdown and avalanche breakdown.	6	L2	5	
	b)	Derive an expression for the conductivity of an intrinsic semiconductor. Discuss the effect of temperature on conductivity of intrinsic semiconductors and how to evaluate energy band gap of a semiconductor.	10	L2	5	
	c)	A sample of silicon semiconductor is doped with 10^{22} phosphorous atoms. Calculate its conductivity if mobility of electrons is 0.07 m^2/Vs. What is the Hall voltage if this semiconductor with a thickness of 100 μm and carrying a current of 1 mA is placed perpendicular to a magnetic field of 0.1T.	4	L3	5	

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

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