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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 - January 2017

16PH102 – 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, $m=9.11\times10^{-31}$kg, Electron charge, $e=1.6\times10^{-19}$C, Permittivity of vacuum, $\varepsilon_0 = 8.85\times10^{-12}$ F/m, Boltzmann constant, $k=1.38\times10^{-23}$J/K. Permeability of free space, $\mu_0=1.26\times10^{-6}$wb/Am

Avogadro Number, $N_A=6.022\times10^{26}$ /kgmole.

			Marks	BL
		Unit – I		
1.	a)	What are matter waves? Mention their characteristics.	6	L
	b)	Derive Schrodinger's time independent wave equation in one dimension for a particle of mass m with energy E.	10	
	c)	An electron beam is subjected to a potential of 10^4 volts. Find the de Broglie wavelength associated with the electrons.	4	
2.	a)	What is a wave function? Mention its characteristics.	6	
	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	
	c)	An electron is trapped in a one dimensional box of length 1×10^{-10} m. How much energy must be supplied to excite the electron from the ground level to the second excited state.	4	
		Unit – II		
3.	a)	Define interplanar distance. Obtain the expression for interplanar spacing in terms of Miller indices.	6	
	b)	Obtain Bragg's Law. Describe how Bragg's spectrometer is used to determine interplanar spacing of a crystal. Show that for a SCC the ratios of $d_{100}, d_{110}, d_{111}$ is $1:1/\sqrt{2}:1/\sqrt{3}$.	10	
	c)	Obtain Miller indices of a plane that intercepts y and Z axes at b/2 and 3c respectively and parallel to x axis. Also show the plane in a unit cube.	4	
4.	a)	Describe a diamond crystal structure.	6	
	b)	Define unit cell and packing fraction. Obtain the packing fraction of FCC by calculating atomic radius and number of atoms per unit cell.	10	
	c)	Diamond crystallizes in ZnS structure. Calculate its density. Given cell parameter 3.57Å and atomic weight of carbon 12.01.	4	
		Unit – III		
5.	a)	Explain Fermi factor. Discuss the dependence of Fermi factor on temperature in the case of metal.	6	
	b)	What are the assumptions of classical free electron theory? On the basis of free electron theory of metals, obtain an expression for the electrical conductivity of a metal.	10	
	c)	Mobilities of electrons and holes in a sample of intrinsic germanium at 300K are $0.36m^2V^{-1}s^{-1}$ and $0.17m^2V^{-1}s^{-1}$ respectively. If the resistivity of the specimen is 2.12ohm-m, compute the intrinsic carrier density.	4	

P.T.O.

6. a) Define the terms Fermi level and Fermi energy. Explain the effect of temperature on the Fermi level in an extrinsic n-type semiconductor. 6
   b) What is Hall effect? Discuss the origin of Hall effect and obtain the expression for Hall voltage and mobility in terms of carrier concentration. 10
   c) Find the temperature at which there is 1% probability that a state at an energy level 0.5 eV above Fermi level will be occupied. 4

Unit – IV

7. a) What is an optical fiber? Explain the construction and principle on the basis of which optical transmission is achieved through a fiber. 6
   b) Explain with a neat sketch the construction and working of ruby laser. Write any four difference between the ruby laser and He-Ne laser. 10
   c) Calculate the wavelength of emission from a GaAs semiconductor laser whose band gap energy is 1.44 eV. 4
8. a) Explain the principle of stimulated emission of radiation in laser. What are the conditions needed for laser action ? 6
   b) What are the different modes of propagation possible in optical fibers? Explain in detail with necessary diagrams. 10
   c) The angle of acceptance of an optical fiber is 30° when kept in air. Find the angle of acceptance when it is in a medium of refractive index 1.33 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 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 -0.3x10-5.Calculate its magnetization, Also evaluate the magnetic flux density of the field inside the material. 4
10. a) What are superconductors? Mention their properties and applications. 6
    b) Explain magnetic hysteresis on the basis of domain theory. Mention some applications of ferromagnetic materials. 10
    c) Write a note on carbon nanotube. 4

BT* Bloom's Taxonomy, L* Level

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NMAM INSTITUTE OF TECHNOLOGY, NITTE

(An Autonomous Institution affiliated to VTU, Belagavi)

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

April - May 2017

16PH102 – 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, $m=9.11\times10^{-31}$kg, Electron charge, $e=1.6\times10^{-19}$C, Permittivity of vacuum, $\varepsilon_0 = 8.85 \times 10^{-12}$ F/m, Boltzmann constant, $k=1.38\times10^{-23}$J/K

Permeability of free space, $\mu_0 = 1.26x10^{-6}\ Wb/Am$.

Avogadro Number, $N_A=6.022\times10^{26}$/ kg mole.

			Marks	BT*
		Unit – I		
1.	a)	What is a wave function? Explain its physical significance.	6	L*2
	b)	Solve Schrodinger's wave equation for a particle in an infinitely deep potential well of width L and obtain the expression for energy Eigen value and corresponding Eigen function.	10	L4
	c)	Find the de Broglie wavelength associated with an electron travelling with a velocity 10^6 m/s.	4	L3
2.	a)	Define phase velocity. Obtain an expression for the same.	6	L4
	b)	What is a free particle? Solve Schrodinger's wave equation for a free particle. What conclusions can we draw about the energy of the free particle?	10	L4
	c)	Find the energy of the electron in the first two excited state moving in a one dimension potential well of width 2Å of infinite height. Also calculate the wave function at x=a/2.	4	L3
		Unit – II		
3.	a)	Explain unit cell, Bravais lattice and Primitive cell in crystals.	6	L1
	b)	Define packing factor and coordination number. Calculate packing factor for a FCC crystal structure. Also calculate number of atoms per unit cell, atomic radius and coordination number with suitable diagrams.	10	L3
	c)	Cesium crystallizes in a certain type of cubic structure with lattice constant 6.14Å. Indentify the exact type of structure in which it crystallizes. Given atomic weight and density of cesium are 132.91 and $1.9 g/cm^3$.	4	L4
4.	a)	What are X rays? Mention their characteristic properties.	6	L3
	b)	Describe the production of X rays. Explain the origin of continuous X rays.	10	L3
	c)	First order Bragg's reflection occurs when a monochromatic X ray beam of wavelength 0.675Å is incident on a crystal at a glancing angle of 4°51'. What is the glancing angle for 3rd order Bragg reflection to occur?	4	L4
		Unit – III		
5.	a)	Explain the effect of temperature on the Fermi level in intrinsic and extrinsic n-type semiconductors.	6	L2 L1
	b)	Obtain an expression for the electrical conductivity of a metal based on classical free electron theory. What are the drawbacks of classical free electron theory?	10	L4
	c)	Find the resistance of an intrinsic Germanium rod, 1cm long, 1mm wide and 1mm thick at 300K. Given for Germanium intrinsic carrier concentration is 2.5 x $10^{19}/m^3$, mobilities of electrons and holes are 0.39 $m^2V^{-1}s^{-1}$ and 0.19 $m^2V^{-1}s^{-1}$ respectively.	4	L3

P.T.O.

6. a) Explain Fermi factor. Discuss the dependence of Fermi factor on temperature. 6
   b) Obtain an expression for the electrical conductivity of an intrinsic semiconductor.Explain the effect of temperature on electrical conductivity of intrinsic and extrinsic semiconductor. 10
   c) Find the probability that an energy level at 0.2eV below Fermi level being occupied at a temperature of 300K. 4

Unit – IV

7. a) What is an optical fiber? Write the difference between optical fiber and the conventional cable. 6
   b) Explain with a neat sketch the construction and working of He-Ne laser. Mention its applications. 10
   c) The ratio of population of two energy level is 1.059×10^{-30}. Calculate the wavelength of the emitted photon at 300 K. 4

8. a) What are the relative advantages and disadvantages of three level and four level lasers. Briefly mention the applications of lasers. 6
   b) Define numerical aperture. Derive an expression for numerical aperture and angle of acceptance of fiber in terms of refractive index of core and cladding. 10
   c) A fiber has a core diameter of 6 μm and its core refractive index is 1.47 and for cladding it is 1.43. How many modes can propagate into the fiber if the wavelength of the source is 1.5 μm. 4

Unit – V

9. a) What are ferroelectric materials? Explain hysteresis loop exhibited by ferroelectric materials. 6
   b) What are nano materials? Explain the two approaches for their preparation. 10
   c) A magnetic field of 2000 A/m is applied to a material which has a susceptibility of 1000. Calculate (1) relative permeability and (2) Intensity of magnetization 4

10. a) What are superconductors? Describe their characteristic properties. 6
    b) What are ultrasonic waves? Explain the generation and properties of ultrasonic waves. 10
    c) Explain the characteristic features of superconductors. 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 2017

16PH102 – 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, $m=9.11\times10^{-31}$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. Permeability of free space, $\mu_o = 1.26x10^{-6} Wb/Am$, Avogadro Number, $N_A=6.022\times10^{26}$/kg mole.

			Marks	BT*
		Unit – I		
1.	a)	What is a wave function? Mention its 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	L4
	c)	Calculate the wavelength associated with an electron subjected to a potential difference of 1.25 kV.	4	L3
2.	a)	Explain matter waves and de-Broglie hypothesis.	6	L2
	b)	Assuming the solution of Schrodinger's wave equation for a particle in an infinitely deep potential well, plot the wave function and probability density as a function of position inside the well, for the first three permitted levels. What conclusion can we draw from them?	10	L4
	c)	Compute the first three permitted energy values for an electron in a box of width of 4Å.	4	L3
		Unit – II		
3.	a)	What are Miller Indices? Explain how Miller Indices are derived.	6	L2
	b)	Explain Lattice points, unit cell, crystallographic directions and any 3 crystal systems with neat diagrams.	10	L3
	c)	Copper has FCC structure of atomic radius 0.1278nm. Calculate the interplanar spacing for(321) planes.	4	L4
4.	a)	Explain the origin of characteristic X - rays.	6	L3
	b)	With a neat sketch explain the production of X - rays and describe the X ray spectrum emitted. Mention any four applications of X - rays.	10	L4
	c)	Calculate the glancing angle of X - rays of wavelength 0.58Å on a plane (132) of sodium chloride which results in second order diffraction maxima. Assume the lattice constant 3.81Å.	4	L4
		Unit – III		
5.	a)	Mention the various reasons for the scattering of electrons in a metal and explain their contribution to the electrical resistivity of metals.	6	L2
	b)	What are extrinsic semiconductors? Describe the mechanisms of carrier generation in extrinsic semiconductors.Obtain an expression for the electrical conductivity of an extrinsic semiconductor.	10	L4

P.T.O.

c) Find the conductivity of intrinsic Germanium if the density of intrinsic charge carriers at 300K is $2.4X10^{19}$ /m^3 and the mobilities of electrons and holes in Germanium are $0.39m^2V^{-1}s^{-1}$ and $0.19m^2V^{-1}s^{-1}$ respectively. Also calculate the conductivity if donor type impurity is added to the extent of one impurity atom per 10^8Germanium atoms. Given the number of Germanium atoms per unit volume are $4.4 \times 10^{28}/m^3$. 4

6. a) Explain the terms drift velocity and relaxation time. What are the drawbacks (failures) of classical free electron theory? 6

b) Explain Hall effect? Obtain an expression for the Hall voltage and mobility of an n-type semiconductor. Mention applications of Hall effect. 10

c) Calculate the drift velocity and thermal velocity of conduction electrons in copper at a temperature of 300K, when a copper wire of length 2m and resistance 0.02Ω carries a current of 15A. Given the mobility of free electrons in copper is 4.3×10^{-3} $m^2/V/s$. 4

Unit – IV

7. a) Explain the terms Population inversion and Meta stable state. What are the basic components required for the construction of a laser? 6

b) With a neat sketch explain the principle, construction and working of semiconductor laser. 10

c) A He-Ne laser emits light at a wavelength of 632.8 nm and has an output power of 2.3 mW. How many photons are emitted in each minute by this laser when operating? 4

8. a) Explain the basic principle and working of optical fiber. 6

b) What is attenuation in an optical fiber? Explain the various possible reasons for the same. 10

c) The fractional index change of an optical fiber and refractive index of core are 0.00515 and 1.533 respectively. Determine the refractive index of cladding. 4

Unit – V

9. a) With a neat diagram, describe saturation polarization, remanent polarization, and coercive filed with reference to ferroelectric hysteresis. 6

b) What are ultrasonic waves? Describe a method of measuring velocity of ultrasonic waves in a liquid. 10

c) Explain the different types of ferromagnetic materials with proper examples. 4

10. a) Write a note on Cryotron. 6

b) With an example, describe the bottom-up approach for preparing of mano-materials. 10

c) What is the polarization produced in sodium chloride by an electric field of $500Vm^{-1}$, if it has a relative permittivity of 6? 4

BT* Bloom's Taxonomy, L* Level

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