NMAM INSTITUTE OF TECHNOLOGY, NITTE
Off-Campus Centre of Nitte (Deemed to be University)
First Semester B.Tech. (CBCS) Degree Examinations
December 2022
PH1001-1 – ENGINEERING PHYSICS

Duration: 3 Hours | Max. Marks:100

Note:
*Part – A: Multiple Choice Questions: Answer all **Twenty** questions in the **OMR Sheet** provided. Each question carries equal marks.*
*Part – B: Descriptive Answer type Questions: Answer **Five full** questions choosing **Two full** questions from **Unit – I & Unit – II each** and **One full** question from **Unit – III.***

List of constants: *Velocity of light, $c=3x10^8ms^{-1}$, Planck's constant, $h=6.63x10^{-34}$ Js, Electron mass, $m=9.11x10^{-31}kg$, Electron charge, $e=1.6x10^{-19}C$, Boltzmann constant, $k=1.38x10^{-23}J/K$. Avogadro number, $NA = 6.022 \times 10^{26}$/ kg mole.*

20 Marks

PART - A: MULTIPLE CHOICE QUESTIONS

1. **Experimental evidence for matter waves is**
   A) photoelectric effect B) compton effect
   C) electron diffraction D) interference of light
2. **The kinetic energy of electron and proton is the same. The relation between their de-broglie wavelengths λ_e and λ_p is**
   A) $\lambda_e = \lambda_p$ B) $\lambda_e < \lambda_p$
   C) $\lambda_e > \lambda_p$ D) $\lambda_e = 2\lambda_p$
3. **Schrodinger's time independent equation is applicable for the particles with**
   A) constant energy B) variable energy
   C) only constant potential energy D) all of these
4. **In a one-dimensional infinite potential well, energy of the particle En =**
   A) $n^2h^2/8mL^2$ B) ~~$n^2h^2/8mL^2$~~ $n^2h^2/8mL^2$
   C) $n^2h^2/2mL^2$ D) $n^2h^2/4mL^2$
5. **If the atoms or molecules in a solid are periodical at regular intervals of distances in three dimensions, then that solid is known as:**
   A) crystalline solid B) amorphous solid
   C) liquid crystals D) none of these
6. **A cubic crystal system is represented by:**
   A) $a = b = c \quad \alpha = \beta = \gamma \neq 90°$ B) $a = b \neq c \quad \alpha = \beta = \gamma = 90°$
   C) $a = b = c \quad \alpha = \beta = \gamma = 90°$ D) $a \neq b \neq c \quad \alpha = \beta = \gamma = 90°$
7. **The Miller indices of the plane parallel to the X & Y axes and intersecting Z axis at 1 unit are**
   A) (1 0 0) B) (0 1 0)
   C) (0 0 1) D) (1 1 0)
8. **Wavelength of the X-ray ranges between ... to ...**
   A) 0.1Å - 100Å B) 0.1μm - 100μm
   C) 0.1mm - 100mm D) 0.1m - 100m
9. **A semiconductor is formed by ..... bonds.**
   A) Covalent B) Electrovalent
   C) Co-ordinate D) None of these
10. **A semiconductor has ..... temperature coefficient of resistance.**
    A) Positive B) Zero
    C) Negative D) None of these
11. **The most commonly used semiconductor is .....**
    A) Germanium B) Silicon
    C) Carbon D) Sulphur
12. **At equilibrium Lorentz force will be _____ to force due to Hall field.**
    A) Double B) Half
    C) Equal D) Not equal

13. **The magnetic lines of force cannot penetrate the body of a superconductor, this phenomenon is known as**
A) Isotopic effect B) Joule's effect
C) Meissner effect D) Silsbee's effect

14. **The minimum amount of current passed through the body of superconductor in order to destroy the superconductivity is called**
A) Induced current B) Critical current
C) Eddy current D) Hall current

15. **A solar cell is a _____**
A) P-type semiconductor B) N-type semiconductor
C) Intrinsic semiconductor D) P-N Junction

16. **Difference between a photodiode and a solar cell is**
A) Photodiode works the opposite way a solar cell works B) Both are similar whereas photodiode is a sensor and solar cell is used for power generation
C) Photodiodes are always reverse biassed and solar cells are forward biassed. D) Photodiodes are made of pure semiconductors and solar cells are made of compounds.

17. **Important characteristic of laser beam is**
A) Interference B) Diffraction
C) Dispersion D) Coherence

18. **Emission of a photon by an excited atom due to interaction with a passing photon nearby is called**
A) Spontaneous emission B) Induced absorption
C) Stimulated emission D) Thermionic emission

19. **Which of the following has more distortion?**
A) Single mode step-index fibre B) Graded index fibre
C) Multimode step-index fibre D) Glass fibre

20. **What causes microscopic bend?**
A) Uniform pressure B) Non-uniform volume
C) Uniform volume D) Non-uniform pressure

PART - B: DESCRIPTIVE ANSWER QUESTIONS

		Unit – I	Marks	BT*	CO*	PO*
1.	a)	Define wavefunction and mention the conditions for a valid wavefunction.	4	L1	1	1,2
	b)	Derive one dimensional time dependent Schrödinger wave equation.	8	L2	1	1,2
	c)	Calculate the de-Broglie wavelength of an electron moving with a velocity of 10^6 m/s.	4	L3	1	1,2
2.	a)	Explain primitive and non-primitive unit cells with appropriate diagrams.	4	L1	2	1,2
	b)	Define coordination number and atomic packing factor. Determine the atomic packing factor for the case of face centered cubic (FCC) lattice by calculating number of atoms/unit cell and obtaining the relation between atomic radius and lattice constant.	8	L2	2	1,2
	c)	The interplanar distance of (110) planes is 2Å for an FCC crystal. Find out the atomic radius.	4	L3	2	1,2
3.	a)	Explain the origin of continuous X-rays with appropriate diagrams.	6	L1	2	1,2
	b)	Derive Bragg's law for X-ray diffraction.	6	L2	2	1,2
	c)	An X-ray machine has an accelerating potential of 35 kV. Find the shortest wavelength produced.	4	L3	2	1,2

Unit – II

4.	a)	Explain the classification of solids based on band theory of solids with appropriate band diagrams.	6	L1	3	1,2
	b)	Derive an expression for electrical conductivity of intrinsic semiconductor.	6	L2	3	1,2
	c)	Calculate the conductivity of silicon doped with 10^{21} atoms m^{-3} of boron if the mobility of holes is 0.048 $m^2/v.s$.	4	L3	3	1,2
5.	a)	Explain direct and indirect band gap semiconductors with E-k diagrams.	6	L1	3	1,2
	b)	Explain the probability of occupation for the energy levels $E<E_F$ and $E>E_F$ at T = 0K.	6	L2	3	1,2
	c)	A semiconductor sample of thickness 100 μm is placed in a magnetic field of 0.1T acting perpendicular to its thickness. Find the Hall voltage generated when a current of 100 mA passes through it. Assume the carrier concentration to be 10^{22} m^{-3}.	4	L3	3	1,2
6.	a)	Explain the construction and working of LED with appropriate diagrams.	6	L1	3	1,2
	b)	Explain Type-I and Type-II superconductors with appropriate diagrams.	6	L2	4	1,2
	c)	A particular green LED emits a light of wavelength 5490 Å. Calculate the band gap of the semiconductor material used in eV.	4	L3	3	1,2

Unit – III

7.	a)	Explain spontaneous emission and stimulated emission with appropriate energy level diagrams.	4	L1	5	1,2
	b)	Explain the construction and working of a He-Ne laser with neat appropriate diagrams.	8	L2	5	1,2
	c)	The ratio of population of two energy levels is 1.059×10^{-30}. Find the wavelength of light emitted at 300 K.	4	L3	5	1,2
8.	a)	Define numerical aperture. Derive an expression for numerical aperture of optical fibre.	6	L1	5	1,2
	b)	Explain step-index single mode and step-index multi mode of optical fibers with appropriate diagrams.	6	L2	5	1,2
	c)	The Refractive index of core-cladding materials of step index fibre is 1.48 and 1.45 respectively. Calculate (i) critical angle at the core-cladding interface and (ii) Fractional refractive index change.	4	L3	5	1,2

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

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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 2022

21PH102 – ENGINEERING PHYSICS

Duration: 3 Hours

Max. Marks: 100

Note: *Answer **Five full** questions choosing **Two full** questions from **Unit – I & Unit – II** each and **One full** question from **Unit – III.***

List of constants: *Velocity of light, $c=3x10^8ms^{-1}$, Planck's constant, $h=6.63x10^{-34}$ Js, Electron mass, $m=9.11x10^{-31}kg$, Electron charge, $e=1.6x10^{-19}C$, Boltzmann constant, $k=1.38x10^{-23}J/K$. Avogadro number, $N_A = 6.022 \times 10^{25}/kg$ mole.*

		Marks	BT*	CO*	PO*
	Unit – I				
1. a)	Explain the terms i) Matter waves, ii) Wave function and iii) Probability density.	6	L*1	1	1,2
b)	Using 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 ground state, first excited state and second excited state. What conclusions can we draw from them?	10	L2	1	1,2
c)	Calculate the wavelength associated with an electron subjected to a potential difference of 1.25 kV.	4	L3	1	1,2
2. a)	Explain the terms i) Space lattice, ii) Unit cell, iii) Coordination number and iv) Atomic packing factor.	6	L1	2	1,2
b)	Define inter planar distance and Miller indices. Derive an expression for inter planar distance in terms of Miller indices for the case of a cubic crystal.	10	L2	2	1,2
c)	The inter planar distance of (110) planes is 2Å for an FCC crystal. Find out the atomic radius.	4	L3	2	1,2
3. a)	Derive Bragg's law for X-ray diffraction.	6	L1	2	1,2
b)	What are X-rays? Mention their properties. With necessary diagrams, explain the origin of characteristic X-rays.	10	L2	2	1,2
c)	An X-ray machine has an accelerating potential of 25 kV. Find the shortest wavelength present in the X-ray spectrum. Also calculate the energy of the X-ray photon.	4	L3	2	1,2
	Unit – II				
4. a)	Explain direct and indirect band gap semiconductors.	6	L1	3	1,2
b)	What are intrinsic and extrinsic semiconductors? Explain in detail Fermi level in intrinsic, n-type and p-type semiconductors with band diagram.	10	L2	3	1,2
c)	Calculate the resistivity of intrinsic germanium if the intrinsic carrier density is 2.5×10^{19} m^{-3} assuming electron and hole mobilities of 0.38 and 0.18 $m^2v^{-1}s^{-1}$.	4	L3	3	1,2
5. a)	Explain the effect of temperature on the conductivity of an intrinsic semiconductor. Also explain how energy band gap can be determined.	6	L1	3	1,2
b)	What is Hall effect? Explain the production of Hall field and obtain an expression for the Hall coefficient and carrier concentration of an n-type semiconductor.	10	L2	3	1,2

P.T.O.

6.	a)	Explain the effect of impurity and temperature on the electrical resistivity of metals.	6	L2	3
	b)	Discuss the Meissner effect in superconductors. Explain the magnetic behavior of Type – I and Type – II superconductors.	10	L2	3
	c)	The critical temperature and critical magnetic 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	3

Unit – IV

7.	a)	Explain the construction and working of a solar cell.	6	L2	4
	b)	What is Hall effect? Explain the production of Hall field and obtain an expression for the carrier concentration of an n type semiconductor and Hall coefficient.	10	L2	4
	c)	Mobilities of electrons and holes in a sample of intrinsic germanium at 300 K are 0.36 $m^2 V^{-1}S^{-1}$ and 0.17 $m^2 V^{-1}S^{-1}$ respectively. If the resistivity of the specimen is 2.12 Ωm, compute the intrinsic carrier density.	4	L3	4
8.	a)	Explain the effect of temperature on the Fermi level in an extrinsic p-type semiconductor.	6	L2	4
	b)	Derive an expression for the electrical conductivity of an intrinsic semiconductor in terms of carrier concentration and carrier mobilities.	10	L2	4
	c)	An n-type semiconductor has a Hall coefficient of $3.66X10^{-4}$ m^3C^{-1} and its resistivity is found to be 2.12 Ωm. Calculate charge carrier concentration and electron mobility at room temperature.	4	L3	4

Unit – V

9.	a)	What is a laser? Explain the principle of spontaneous emission and stimulated emission of radiation.	6	L2	5
	b)	With neat diagrams, describe the construction and working of ruby laser.	10	L2	5
	c)	A He-Ne laser has an output power of 10mW and emits light at a wavelength of 632.8 nm. How many photons are emitted by the laser in each minute?	4	L3	5
10.	a)	What is an optical fiber? Explain the principle on the basis of which optical transmission is achieved through a fiber.	6	L2	5
	b)	Obtain an expression for the numerical aperture of the optical fiber. Describe multimode step index optical fiber.	10	L2	5
	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	L3	5

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

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NMAM INSTITUTE OF TECHNOLOGY, NITTE

(An Autonomous Institution affiliated to VTU, Belagavi)

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

Supplementary Examinations - September 2023

20PH102 – ENGINEERING PHYSICS

uration: 3 Hours Max. Marks: 100

ist 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, Permittivity of vacuum, $\varepsilon_0 = 8.85\times10^{-12}$ F/m, Boltzmann constant, $k=1.30\times10^{-23}$J/K. Avogadro number, $N_A = 6.023 \times 10^{26}$/ kg mole.

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

			Marks	BT*	CO*	PO*
		Unit – I				
1.	a)	What are matter waves? Write their characteristics.	6	L*2	1	1, 2
	b)	What is a wave function? Obtain an expression for one dimensional time independent Schrodinger's wave equation.	10	L2	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
2.	a)	Explain the terms:(i) Probability density (ii) Normalization of a wave function.	6	L2	1	1,2
	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	1	1,2
	c)	An electron is confined to move between two rigid walls separated by 20 Å. Calculate the ground state energy of an electron and its de-Broglie wavelength (assume the potential to be zero).	4	L3	1	1,2
		Unit – II				
3.	a)	Explain Space lattice. Explain any four crystal systems and mention their characteristic parameters.	6	L2	2	1,2
	b)	What are X-rays? Mention its properties. With necessary diagrams, explain the origin of continuous X-rays.	10	L2	2	1,2
	c)	Cesium crystallizes in a certain type of cubic structure with lattice constant 6.14 Å. Identify the exact type of crystal structure in which it crystallizes, given that the atomic weight and density of cesium are 132.91 and 1900 kg/m^3 respectively.	4	L3	2	1,2
4.	a)	Describe the crystal structure of sodium chloride.	6	L2	2	1,2
	b)	What is atomic packing factor? Determine the atomic packing factor for face centered cubic (FCC) lattice by calculating number of atoms per unit cell and obtain the relation between atomic radius and lattice constant.	10	L3	2	1,2
	c)	A monochromatic X-ray beam of wavelength 0.7 Å undergoes first order Bragg reflection from the plane (3 0 2) of a cubic crystal at a glancing angle of 35°. Calculate the lattice constant.	4	L3	2	1,2
		Unit – III				
5.	a)	What are superconductors? Explain its characteristic properties.	6	L2	3	1,2
	b)	What are the basic assumptions of the classical free electron theory? Obtain an expression for the electrical conductivity of a metal.	10	L3	3	1,2
	c)	Find the temperature at which there is 2% probability that a state with an energy 0.3 eV above Fermi energy is occupied.	4	L3	3	1,2

P.T.O.

	c)	The mobility and charge carrier concentration of the specimen are 0.041 m^2/Vs and $1.7 \times 10^{22}/m^3$ respectively. Calculate Hall co-efficient and resistivity of the specimen.	4	L3	3
6.	a)	Explain the principle, construction and working of photo diode with necessary diagrams.	6	L1	3
	b)	Discuss i) Isotope effect ii) Meissner effect in superconductors. Explain the magnetic behaviour of Type - I and Type – II superconductors.	10	L2	4
	c)	A semiconductor sample of thickness 1.2×10^{-4} m is placed in a magnetic field of 0.2T acting perpendicular to its thickness. Find the Hall voltage generated when a current of 100 mA passes through it. Assume the carrier concentration to be 10^{23} m^{-3}.	4	L3	4
		Unit – III			
7.	a)	Explain spontaneous and stimulated emission.	6	L1	5
	b)	Explain the construction and working of a Ruby laser with neat energy level diagram.	10	L2	5
	c)	The ratio of population of two energy levels is 1.059×10^{-30}. Find the wavelength of light emitted at 300 K.	4	L3	5
8.	a)	Explain the terms. i) Optical fiber ii) Numerical aperture and iii) Fractional index change.	6	L1	5
	b)	Explain the different types of optical fibers with suitable diagrams.	10	L2	5
	c)	Calculate the V-number for a fiber of core diameter 40 μm and with refractive indices of 1.55 and 1.50 respectively for core and cladding, when the wavelength of the propagating wave is 1400 nm. Also calculate the number of modes that the fiber can support for propagation. Assume that the fiber is in air.	4	L3	5

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

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NMAM INSTITUTE OF TECHNOLOGY, NITTE

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

September - October 2022

21PH102 – ENGINEERING PHYSICS

Duration: 3 Hours | Max. Marks: 100

*Note: Answer **Five full** questions choosing **Two full** questions from **Unit – I & Unit – II each** and **One full** question from **Unit – III.***

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. Avogadro number, $N_A = 6.023 \times 10^{26}$/kmole

			Marks	BT*	CO*	PO*
		Unit – I				
1.	a)	What is a wave function? Mention its characteristic properties.	6	L*2	1	1,2
	b)	Solve Schorodinger's wave equations for a particle in an infinitely deep potential well of width L and show that the energy values are quantized.	10	L2	1	1,2
	c)	Calculate the de-Broglie wavelength of an electron subjected to a potential difference of 1.5 kV.	4	L3	1	1,2
2.	a)	Define (i) Space lattice (ii) Coordination number (iii) Atomic packing factor.	6	L2	2	1,2
	b)	What are X rays? Write any four characteristic properties. With necessary diagrams, explain the origin of continuous X - rays.	10	L2	2	1,2
	c)	Nickel has fcc structure with lattice constant 3.52 Å. Calculate the interplanar spacing of (101) planes.	4	L3	2	1,2
3.	a)	What is unit cell? With neat diagram, explain any two crystal systems.	6	L2	2	1,2
	b)	Define interplanar spacing and Miller indices. Derive an expression for interplanar spacing in terms of Miller indices.	10	L2	2	1,2
	c)	The lattice constant for a unit cell of aluminum is 4.031 Å. Calculate the inter planar spacing of (211) plane.	4	L3	2	1,2
		Unit – II				
4.	a)	What are super conductors? Explain its characteristic properties.	6	L2	4	1,2
	b)	With neat diagram explain the variation of Fermi level with temperature in intrinsic and extrinsic semiconductors.	10	L2	1	1,2
	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	L3	3	1,2
5.	a)	What are intrinsic semiconductors? Obtain an expression for the conductivity of an intrinsic semiconductor.	6	L2	3	1,2
	b)	Discuss the Meissner effect in superconductors. Explain the magnetic behavior of Type-I and Type – II superconductors.	10	L2	4	1,2
	c)	Calculate the resistivity of intrinsic germanium at 300 K if the intrinsic carrier density is $2.5\times10^{19}\ m^{-3}$ assuming electron and hole mobilities of $0.38\ m^2\ V^{-1}s^{-1}$ and $0.18\ m^2\ V^{-1}s^{-1}$ respectively.	4	L3	3	1,2

P.T.O.

6.	a)	Explain with band diagram, direct band gap and indirect band gap semiconductors.	6	L2	3	1,2
	b)	What is Hall effect? Explain the production of Hall field and obtain an expression for the carrier concentration and Hall coefficient of an n type semiconductor.	10	L2	3	1,2
	c)	Mobilities of electrons and holes in a sample of intrinsic silicon at 300 K are 0.13 m^2/Vs and 0.05 m^2/Vs respectively. If the conductivity of the specimen is $4.32 \times 10^{-4}/\Omega m$, calculate intrinsic concentration.	4	L3	3	1,2

Unit – III

7.	a)	What are lasers? Describe the construction and working of a Ruby laser.	6	L2	5	1,
	b)	Describe the attenuation in the optical fiber. What are the advantages of optical communications over other conventional types of communication?	10	L2	5	1,1
	c)	The ratio of the population of two energy levels is 1.059×10^{-30}. Find the wavelength of light emitted at 300 K.	4	L3	5	1,
8.	a)	Explain the terms: (i) population inversion (ii) metastable state and (iii) stimulated emission.	6	L2	5	1,
	b)	Obtain an expression for the numerical aperture of the optical fiber. Describe the types of optical fibers and modes of transmission.	10	L2	5	1,
	c)	A step index optical fiber has a core of refractive index 1.53 and a cladding of index 1.39. Assume fiber is in air medium. Determine (i) the numerical aperture of the fiber and (ii) the critical angle for core - cladding interface.	4	L3	5	1

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