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18PHY12/22

# First/Second Semester B.E. Degree Examination, June/July 2023
## Engineering Physics

Time: 3 hrs. Max. Marks: 100

**Note:** ***Answer any FIVE full questions, choosing ONE full question from each module.***



### Module-1

1 a. Define Simple Harmonic Motion. Derive differential equation for SHM using Hooke's law. **(06 Marks)**

b. What are damped oscillations? Give the theory of damped oscillations and find the condition for critical damping. **(10 Marks)**

c. Calculate Mach number for a body when it is moving in air with a speed of 2000km/hr and 380km/hr. Classify these speeds as subsonic or supersonic or hypersonic. **(04 Marks)**

**OR**

2 a. What is Mach number? Describe the working of hand operated Reddy shock tube with the help of neat diagram. **(06 Marks)**

b. Obtain an expression for steady state amplitude phase angle in case of forced oscillations. **(10 Marks)**

c. A mass of 0.5kg causes an extension of 0.03m in a spring and the system is set for oscillations. Calculate spring constant and its angular frequency. **(04 Marks)**

### Module-2

3 a. Explain the nature of elasticity with the help of stress-strain diagram. **(06 Marks)**

b. Define Young's modulus? Derive the relation between Y, K and $\sigma$, where Y is Young's modulus, K is bulk modulus and $\sigma$ is Poisson's ratio. **(10 Marks)**

c. One end of wire of diameter 8mm and 1m in length is twisted trough 60°. Calculate the angle of shear on its surface. **(04 Marks)**

**OR**

4 a. Explain the term 'Bending Moment'. Obtain an expression for bending moment of a their uniform bar of rectangular cross section. **(10 Marks)**

b. Show that for an elastic-body, shear strain is equal to sum of longitudinal strain and compressional strain. **(06 Marks)**

c. Calculate the elongation produced in a wire of length 1m and radius $0.01 \times 10^{-2}$m due to a force of 10N applied along its length. Given Young's modulus = $2.1 \times 10^{11}$N/m$^2$. **(04 Marks)**

### Module-3

5 a. State Gauss law in electrostatics and magneto-statics. Write Maxwell's equations for time varying conditions and explain the terms. **(08 Marks)**

b. Define displacement current and obtain its expression. **(08 Marks)**

c. Calculate the refractive index of the cladding of an optical fiber, if the refractive index of the core is 1.533 and fractional index charge is 0.00515. **(04 Marks)**

**OR**

6 a. Derive the wave equation for electromagnetic waves using Maxwell's equations. **(10 Marks)**

b. What is attenuation in optical fiber? Discuss point-to-point communication system using optical fiber with the help of block diagram. **(06 Marks)**

c. A coil of mean radius 8cm and having 100 turns carries a current of 10A. Calculate the magnetic field produced at the centre of the coil and at a point on the axis at the a distance of 4cm from the center. **(04 Marks)**

## Module-4

7 a. State and explain Heisenberg uncertainty principal. Show that electron does not exist inside the nucleus. **(06 Marks)**

b. Derive one dimensional time independent Schrodinger wave equation and reduce the same equation for a free particle. **(10 Marks)**

c. A pulse laser emits pulses of 10ns duration with average power pulse being 0.16MW. If the wavelength of laser sources is 694.3nm, calculate the member of photons in each pulse. **(04 Marks)**

**OR**

8 a. Explain induced absorption, spontaneous emission and stimulated emission with their rate equations. **(06 Marks)**

b. Describe construction and working of $CO_2$ laser and mention any tow of its applications. **(10 Marks)**

c. Find the energy spacing between first and third excited states of an electron confined to a potential well of infinite height and finite width 1Å. **(04 Marks)**

## Module-5

9 a. Mention any four assumptions of quantum free electron theory. Explain any two failures of classical free electron theory. **(06 Marks)**

b. Define Fermi energy. Derive an expression for Fermienergy at absolute zero temperature. **(10 Marks)**

c. The atomic weight and density of a material are 32 and $2.08 \times 10^3$ kg/m$^3$ respectively. The electronic polarizability of the atom is $3.28 \times 10^{-40}$Fm$^2$. If the given material has cubic structure, calculate its dielectric constant. **(04 Marks)**

**OR**

10 a. What is Hall effect? Obtain expression for Hall coefficient. **(08 Marks)**

b. Describe different polarization mechanisms with the required diagrams. **(08 Marks)**

c. Calculate the probably of an electron occupying an energy level 0.02eV below the Fermi-level at 200K. **(04 Marks)**

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BPHYM102/202

# First/Second Semester B.E./B.Tech.Degree Examination, June/July 2023
## Applied Physics for ME Stream

Time: 3 hrs. Max. Marks: 100

***Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.***
***2. VTU Formula Hand Book is permitted.***
***3. M : Marks , L: Bloom's level , C: Course outcomes.***

| | | Module – 1 | M | L | C |
|---|---|---|---|---|---|
| Q.1 | a. | Define force constant. Derive the expressions for equivalent force constant for two springs connected in series and parallel combination. | 9 | L2 | CO1 |
| | b. | Describe the construction and working of Reddy shock tube with the help of a diagram. | 7 | L2 | CO1 |
| | c. | The distance between the two pressure sensors in shock tube is 100 mm. The time taken by a shock wave to travel this distance is 195 microsecond. If the velocity of sound under the same condition is 340 m/s. Find the Mach number of the shock wave. | 4 | L3 | CO1 |
| | | **OR** | | | |
| Q.2 | a. | Obtain a differential equation for a body undergoing forced oscillation and mention expression for amplitude and phase of forced oscillation. | 8 | L2 | CO1 |
| | b. | What are shock waves? Mention three characteristics and applications of shock waves. | 7 | L2 | CO1 |
| | c. | In series resonance experiment, a 50 μF capacitor, when connected in series with a coil having a resistance of 40 Ω, resonates at 1000 Hz. Calculate the inductance of the coil for the resonant circuit. | 5 | L3 | CO5 |
| | | **Module – 2** | | | |
| Q.3 | a. | Define bending moment. Derive the expression for bending moment interms of moment of inertia. | 10 | L2 | CO1 |
| | b. | Explain the nature of elasticity with the help of stress-strain diagram. | 6 | L2 | CO1 |
| | c. | The Bulk modulus for a material is $60\times10^9$ N/m$^2$ and its modulus of rigidity is $40\times10^9$ N/m$^2$. Calculate its Young's modulus for the given material. | 4 | L3 | CO1 |
| | | **OR** | | | |
| Q.4 | a. | Define Young's modulus, Bulk modulus and rigidity modulus. Derive the relation between Y, η and σ. | 9 | L2 | CO1 |
| | b. | Explain the various types of beams and mention their engineering applications. | 6 | L2 | CO1 |
| | c. | Calculate the force required to produce an extension of 1 mm in steel wire of length 2 m and diameter 1 mm. (Given : Young's modulus of wire, $Y = 2\times10^{11}$ N/m$^2$). | 5 | L3 | CO1 |
| | | **Module – 3** | | | |
| Q.5 | a. | Discuss the Seebeck effect and Peltier effect with their coefficients. | 8 | L2 | CO2 |
| | b. | Describe the construction and working of Thermoelectric Generator (TEG). | 7 | L2 | CO2 |

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|---|---|---|---|---|---|
| | c. | The thermo emf of a thermocouple is 1200 μV when the cold junction is at 0°C and hot junction at 100°C. Calculate the constants a and b if the neutral temperature is 300°C. | 5 | L3 | CO2 |
| | | **OR** | | | |
| Q.6 | a. | Describe the construction and working of Thermocouples. Mention their advantages. | 9 | L2 | CO2 |
| | b. | Explain the application of thermoelectricity on Refrigerator. | 6 | L2 | CO2 |
| | c. | The emf in microvolts of a thermocouple, one junction of which is at 0°C is given by $e = 1600\,T - 4T^2$ where T°C is the temperature of hot junction. Find the neutral temperature and Peltier coefficient. | 5 | L3 | CO2 |
| | | **Module – 4** | | | |
| Q.7 | a. | Derive $\Delta T = \frac{(P_1 - P_2)}{C_P}\left[\frac{2a}{RT} - b\right]$ and hence discuss three cases. | 9 | L2 | CO3 |
| | b. | Describe the construction and working of Platinum Resistance Thermometer. | 7 | L2 | CO3 |
| | c. | In Joule-Thomson experiment temperature changes from 100°C to 150°C for pressure change of 20 MPa to 170 MPa. Calculate Joule-Thomson coefficient. | 4 | L3 | CO3 |
| | | **OR** | | | |
| Q.8 | a. | Describe the construction and working of Porous plug experiment. What conclusions have been drawn from it. | 9 | L2 | CO3 |
| | b. | Explain the construction and working of Lindey's air Liquefier. | 7 | L2 | CO3 |
| | c. | In a diffraction grating experiment the laser light undergoes second order diffraction for diffraction angle 1.48°. The grating constant $d = 5\times10^{-5}$ m and the distance between the grating and screen is 1 m, find the wavelength of LASER light. | 4 | L3 | CO5 |
| | | **Module – 5** | | | |
| Q.9 | a. | With a neat diagram, explain the principle, construction and working of Scanning Electron Microscopy. | 8 | L2 | CO4 |
| | b. | Explain the construction and working of X-ray diffractometer. | 7 | L2 | CO4 |
| | c. | Determine the crystal size when the peak width is 0.5° and peak position 30° for a cubic crystal. The wavelength of X-rays used is 100 Å and the Scherrer's constant K = 0.92. | 5 | L3 | CO4 |
| | | **OR** | | | |
| Q.10 | a. | Describe the principle, construction and working of Atomic Force Microscopy with the help of a neat diagram. | 8 | L2 | CO4 |
| | b. | Describe the principle, construction and working of Transmission Electron Microscopy. | 8 | L2 | CO4 |
| | c. | A beam of monochromatic X-rays is diffracted by NaCl crystal with a glancing angle of 12° for first order. Calculate the wavelength of X-rays if interplanar spacing of the crystal is 2.82 Å. | 4 | L3 | CO4 |

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BPHYS102/202

# First/Second Semester B.E./B.Tech. Degree Examination, June/July2023
## Physics for CSE Stream

Time: 3 hrs. Max. Marks: 100

***Note:*** 1. ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***VTU Formula Hand Book is permitted.***
3. ***M : Marks , L: Bloom's level , C: Course outcomes.***
4. ***Constants : Speed of Light C = 3 × $10^8$ m/s, Boltzmam const. K = 1.38×$10^{-23}$ J/K, Planck's const h = 6.625 × $10^{-34}$ JS, Acceleration due to gravity g = 9.8m/$s^2$, mass of electron m = 9.1 × $10^{-31}$ Kg***

| | | Module – 1 | M | L | C |
|---|---|---|---|---|---|
| Q.1 | a. | Derive an expression for energy density interms of Einstein's coefficients in Laser action. | 10 | L2 | CO1 |
| | b. | Explain types of optical fibers. | 6 | L2 | CO1 |
| | c. | The ratio of population inversion of two energy levels is 1.059 × $10^{-30}$. Find the wavelength of Light emitted by spontaneous emissions at 330K. | 4 | L3 | CO1 |
| | | **OR** | | | |
| Q.2 | a. | Derive an expression for Numerical aperture in an optical fiber. | 8 | L2 | CO1 |
| | b. | Discuss construction and working of semiconductor diode Laser with energy level diagram. | 8 | L2 | CO1 |
| | 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 | L3 | CO1 |
| | | **Module – 2** | | | |
| Q.3 | a. | What is wave packet? Give physical significance and properties of wave function? Define group velocity. | 8 | L2 | CO1 |
| | b. | State and explain Heisenberg's uncertainty principle. Give its physical significance. Show that electron cannot exist inside the nucleus. | 8 | L2 | CO2 |
| | c. | A particle of mass 0.5meV/$c^2$ has kinetic energy 100eV. Find its de Broglie wavelength, where 'C' is the velocity of light. | 4 | L3 | CO2 |
| | | **OR** | | | |
| Q.4 | a. | Derive an expression for Schrödinger's Time independent equation one dimensional form. | 8 | L2 | CO2 |
| | b. | Obtain the expression for energy eigen values using Schrodinger's time independent equation. | 8 | L2 | CO2 |
| | c. | In a measurement of position and velocity of an electron moving with a speed of 6 × $10^5$ m/s, calculate highest accuracy with which its position could be determined, if the inherent error in the measurement of its velocity is 0.01% for the speed stated. | 4 | L3 | CO2 |

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|---|---|---|---|---|---|
| | | **Module – 3** | | | |
| **Q.5** | **a.** | Explain single qubit gate and multiple qubit gate with example for each. | **8** | **L2** | **CO2** |
| | **b.** | Discuss CNOT gate and its operation on four different input states. | **8** | **L2** | **CO2** |
| | **c.** | Given $A = \begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix}$ prove that $A^{+} = A$. | **4** | **L3** | **CO2** |
| | | **OR** | | | |
| **Q.6** | **a.** | Elucidate the differences between classical computing and Quantum computing. | **8** | **L2** | **CO2** |
| | **b.** | Discuss the working of phase gate mentioning its matrix representation and truth table. | **8** | **L2** | **CO2** |
| | **c.** | Find the inner product of states $\|11\rangle$ and $\|10\rangle$ and draw conclusionon the result. | **4** | **L3** | **CO2** |
| | | **Module – 4** | | | |
| **Q.7** | **a.** | Distinguish between Type – I and Type – II super conductors. | **8** | **L2** | **CO3** |
| | **b.** | Discuss the effect of temperature and impurity on electrical resistivity of conductors and hence explain for superconductors. | **8** | **L2** | **CO3** |
| | **c.** | In a diffraction grating experiment the laser light undergoes second order diffraction, if the distance between screen and grating is 20cm, and average distance of $2^{nd}$ order spot 2.7cm grating constant $1 \times 10^{-5}$m, calculate the wavelength of laser light. | **4** | **L3** | **CO5** |
| | | **OR** | | | |
| **Q.8** | **a.** | Explain B.C.S theory of superconductivity. | **7** | **L2** | **CO1** |
| | **b.** | Define Fermi energy level. Discuss various energy states by the electrons at T = O K and T > O K on the basis of fermifactor. | **8** | **L2** | **CO1** |
| | **c.** | Calculate the acceptance angle and numerical aperture of given optical fiber having diameter of spot is 2.6cm and distance between screen and optical fiber 3.0cm. | **5** | **L2** | **CO1** |
| | | **Module – 5** | | | |
| **Q.9** | **a.** | Elucidate the importance of size and scale and weight and strength in animations. | **8** | **L2** | **CO4** |
| | **b.** | Discuss modeling probability of proton decay. | **8** | **L2** | **CO4** |
| | **c.** | The number of particles emitted per second by a random radioactive source has a Poisson's distribution with $\lambda = 4$. Calculate the probability of P(X = 0) and P(X = 1) | **4** | **L3** | **CO4** |
| | | **OR** | | | |
| **Q.10** | **a.** | Discuss timing in Linear motion, uniform motion, show in and flow out. | **8** | **L2** | **CO4** |
| | **b.** | Discuss salient features of Normal distribution using Bell curves. | **8** | **L2** | **CO4** |
| | **c.** | A slowing in object in an animation has a first frame distance 0.5m and first slow in frame 0.35m. Calculate the base distance and the number of frames in sequence. | **4** | **L3** | **CO4** |

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21PHY12/22

# First/Second Semester B.E. Degree Examination, June/July 2023
## Engineering Physics

Time: 3 hrs. Max. Marks: 100

***Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.***
***2. Draw neat sketches wherever necessary.***
***3. Constants: Speed of light "C" = $3 \times 10^8$ m/s, Boltzmann constant "K" = $1.38 \times 10^{-23}$ J/K, Planck's constant "h" = $6.625 \times 10^{-34}$ JS. Acceleration due to gravity "g" = 9.8m/s$^2$, permittivity of free space. "$\epsilon_o$" = $8.854 \times 10^{-12}$ F/m.***



### Module-1

1 a. Obtain the expressions for force constant for series and parallel combination of springs also mention expressions for period of oscillation for series and parallel combination. **(08 Marks)**

b. What are damped oscillations? Establish equation of motion for damped vibrations and obtain its general solution. **(08 Marks)**

c. A car has a spring system that supports the in-built mass 1000kg. When a person with a weight 980N sits at the centre of gravity, the spring system sinks by 2.8cm. When the car hits a bump, it starts oscillating vertically. Find the period and frequency of oscillation. **(04 Marks)**

**OR**

2 a. Give the theory of forced vibration and obtain expression for amplitude and phase. **(08 Marks)**

b. Illustrate the generation of shock waves using the Reddy shock tube and give any four applications of shock waves. **(08 Marks)**

c. The distance between the two pressure sensors in shock tube is 100mm. The time taken by a shock wave to travel this distance is 100 microsecond. If the velocity of sound under the same condition is 340m/s, find the Mach number of the shock wave. **(04 Marks)**

### Module-2

3 a. State Heisenberg uncertainty principle and give its physical significance. Show that electron does not exists inside the nucleus by this principle. **(08 Marks)**

b. Starting from Planck's quantum theory of radiation arrive at Wien's law and Rayleigh Jean's law. **(08 Marks)**

c. Compute the de Broglie wavelength for a neutron moving with one tenth part of the velocity of light, given, mass of neutron = $1.674 \times 10^{-27}$kg. **(04 Marks)**

**OR**

4 a. Set up one-dimensional time-independent Schrodinger's equation. **(08 Marks)**

b. Discuss the eigenfunction, eigenvalues and probability density for a particle in a potential well of infinite height. **(08 Marks)**

c. An electron has a speed of 100m/s. The inherent uncertainty in its measurement is 0.005%. Calculate corresponding uncertainty that arises in the measurement of its position. **(04 Marks)**

## Module-3

5 a. Derive the expression for energy density in terms of Einstein's coefficients. **(06 Marks)**

b. Derive the expression for numerical aperture of an optical fiber and discuss the block diagram of point-to-point communication. **(10 Marks)**

c. The ratio of population of two energy levels is $1.059 \times 10^{-30}$, find the wavelength of light emitted by spontaneous emissions at 330K. **(04 Marks)**

**OR**

6 a. Explain construction and working of $CO_2$ laser with necessary diagrams. **(08 Marks)**

b. What is attenuation? Explain different types of optical fibers. **(08 Marks)**

c. The attenuation of light in an optical-fiber is estimated at 2.2dB/km. What fractional initial intensity remains after 2km and 6km. **(04 Marks)**

## Module-4

7 a. What is Hall effect? Obtain the expression for the Hall coefficient. **(08 Marks)**

b. Define polarization, dipole and dipole moment derive Clausius-Mossotti equation. **(08 Marks)**

c. The resistivity of intrinsic germanium at 27°C is equal to 0.47 ohm-meter. Assuming electron and hole mobilities as 0.38 and $0.18 m^2/vs$ respectively, calculate the intrinsic carrier density. **(04 Marks)**

**OR**

8 a. Define Fermi energy and Fermi factor. Discuss the dependence of Fermi factor on temperature and energy. **(08 Marks)**

b. Discuss merits of quantum free electron theory give expressions for holes and electrons concentration in semiconductors. **(08 Marks)**

c. Find the probability that an energy level at 0.2ev below Fermi level being occupied at temperatures 300K and 1000K. **(04 Marks)**

## Module-5

9 a. With neat diagram, explain the principle, construction and working of X-ray photoelectron spectroscope. **(08 Marks)**

b. With necessary diagram, explain the principle construction and working of Atomic force microscope. **(08 Marks)**

c. X-ray of wavelength 0.12nm are found to undergo second order reflection at a Bragg angle of 28° from crystal. What is the interplanar spacing of the reflecting planes of the crystal? **(04 Marks)**

**OR**

10 a. With the help of neat diagram describe the principle construction and working of scanning electron microscope. **(08 Marks)**

b. Define nano material, mention classification of nano materials explain in brief how crystal size is determined by Scherrer's equation. **(08 Marks)**

c. The spacing between principal planes of the crystals is 2.82 Å. It is found that first order Bragg reflection occurs at an angle of 10°, what is the wavelength of X-rays? **(04 Marks)**

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BPHYC102/202

# First/Second Semester B.E./B.Tech. Degree Examination, June/July 2023
## Applied Physics for Civil Engineering Stream

Time: 3 hrs. Max. Marks: 100

***Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.***
***2. VTU Formula Hand Book is permitted.***
***3. M : Marks , L: Bloom's level , C: Course outcomes.***

| | | Module – 1 | M | L | C |
|---|---|---|---|---|---|
| Q.1 | a. | Define Hooke's law and hence derive expressions for the effective spring constant of springs in series and parallel combination. | 07 | L2 | CO1 |
| | b. | With necessary diagram explain construction and working of Reddy Shock Tube and mention any four of its applications. | 08 | L2 | CO1 |
| | c. | A car has a spring that supports the in-built mass 1000 kg, when a person with a weight 980 N sits at the centre of gravity, the spring system sinks by 2.8 cm. When the car hits a bump, it stood oscillating vertically. Find the period and frequency of oscillation. | 05 | L3 | CO5 |
| | | **OR** | | | |
| Q.2 | a. | Explain various forces acting on a system under damped oscillations, setup differential equation and assuming the solution mention the variation of amplitude with respect to time. | 08 | L2 | CO1 |
| | b. | Explain Mach number, Mach angle, Resonance, Sharpness of resonance. | 07 | L2 | CO1 |
| | c. | A mass 0.5 kg causes an extension 0.03 m in a spring and the system is set for oscillations. Find (i) Force constant K of the spring, (ii) Angular frequency w, (iii) Period T of the resulting oscillation. | 05 | L3 | CO5 |
| | | **Module – 2** | | | |
| Q.3 | a. | Define Poisson's ratio and derive the relation between Young's modulus, Rigidity modulus and Poisson's ratio. | 08 | L2 | CO1 |
| | b. | Define 3 types of Moduli and discuss stress-strain curve. | 08 | L2 | CO1 |
| | c. | Calculate the extension produced in a wire of length 2 m and radius $0.013\times10^{-2}$ m due to a force of 14.7 Newton applied along its length. Given Young's modulus of the material of the wire, $Y = 2.1\times10^{11}$ N/m$^2$. | 04 | L3 | CO5 |
| | | **OR** | | | |
| Q.4 | a. | Explain elongation, compression strain and Poisson's ratio and also arrive at the relation between them and explain limiting values of Poisson's ratio. | 08 | L2 | CO1 |
| | b. | Explain Beam, Types of Beams, bending moment, ductile fracture and brittle fracture. | 08 | L2 | CO1 |
| | c. | Calculate the force required to produce an extension of 1mm in steel wire of length 2 meter and diameter 1mm. Given Young's modulus $Y = 2.1\times10^{11}$ N/m$^2$. | 04 | L3 | CO5 |
| | | **Module – 3** | | | |
| Q.5 | a. | With some relevant points define and explain Lambert's cosine law and Inverse Square law. | 08 | L2 | CO2 |
| | b. | Define Reverberation and Reverberation Time. Discuss Reverberation time optimum value for good auditorium. | 08 | L2 | CO2 |
| | c. | A hall having volume of 1500 m$^3$ has total absorption equivalent to 100 m$^2$ Sabine. Calculate the reverberation time of the hall. | 04 | L3 | CO2 |
| | | **OR** | | | |

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|---|---|---|---|---|---|
| **Q.6** | **a.** | Define Photometry and Radiometry and also define 4 photometric quantities and 4 radiometric quantities. | **10** | **L2** | **CO2** |
| | **b.** | Explain Impact of Noise in Multi-Storied buildings. | **05** | **L2** | **CO2** |
| | **c.** | The volume of room is 1500 $m^3$. The wall area of the room is 260 $m^2$, the floor area is 140 $m^2$, and the ceiling area is 140 $m^2$. The average sound absorption co-coefficient for wall is 0.03, for the ceiling is 0.8 and for the floor is 0.06. Calculate the average absorption co-efficient and the reverberation time. | **05** | **L3** | **CO2** |
| | | **Module – 4** | | | |
| **Q.7** | **a.** | Explain construction and working of semiconductor LASER with necessary diagram. | **08** | **L2** | **CO3** |
| | **b.** | With necessary diagram, explain propagation of light through optical fibre and obtain expression for Numerical Aperture and angle of acceptance. | **08** | **L2** | **CO3** |
| | **c.** | The average output power of Laser source emitting a laser beam of wavelength 6328 A° is 5 mW. Find the number of photons emitted per second by the laser source. | **04** | **L3** | **CO5** |
| | | **OR** | | | |
| **Q.8** | **a.** | What are optical fibers? Explain principle of optical fiber. With neat diagrams explain types of optical fibers. | **10** | **L2** | **CO3** |
| | **b.** | Define Attenuation co-efficient, induced absorption, spontaneous emission, stimulated emission, population inversion, metastable state. | **06** | **L2** | **CO3** |
| | **c.** | An optical fiber has a core material with reactive index 1.55 and its cladding material has a refractive index of 1.5. The light is launched into it in air. Calculate the numerical aperture, the acceptance angle and also the fractional index change. | **04** | **L3** | **CO5** |
| | | **Module – 5** | | | |
| **Q.9** | **a.** | Explain the classification of natural hazards and man-made hazards with examples. | **10** | **L2** | **CO4** |
| | **b.** | Define earthquake and discuss four types of earthquake. | **05** | **L2** | **CO4** |
| | **c.** | A recent earthquake in San Francisco measured 7.1 on the Richter scale. How many times more intense was the San Francisco earthquake earlier registered 8.3 on the Richter scale. | **05** | **L3** | **CO4** |
| | | **OR** | | | |
| **Q.10** | **a.** | Enumerate the causes and adverse effects of tsunami waves. | **08** | **L2** | **CO4** |
| | **b.** | Define landside and describe the causes for landslides. | **08** | **L2** | **CO4** |
| | **c.** | Early in the century the earthquake in San Francisco registered 8.3 on the Richter scale. In the same year, another earthquake was recorded in South America that was four time stronger. What was the magnitude of the earthquake in South America? | **04** | **L3** | **CO4** |

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BPHYE102/202

# First/Second Semester B.E./B.Tech.Degree Examination, June/July 2023
## Applied Physics for EEE Stream

Time: 3 hrs. Max. Marks: 100

***Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.***
***2. VTU Formula Hand Book is permitted.***
***3. M : Marks , L: Bloom's level , C: Course outcomes.***

| | | Module – 1 | M | L | C |
|---|---|---|---|---|---|
| Q.1 | a. | What is Wave function? Setup Time Independent Schrodinger wave equation for a Quantum free particle in one dimension and mention the same in three dimensions. | 9 | L2 | CO1 |
| | b. | Explain de-Broglie hypothesis. Arrive at the expression for de-Broglie wavelength. | 6 | L2 | CO1 |
| | c. | Calculate the energy in first two energy states for an electron in one dimensional infinite potential well of width 1 nm. | 5 | L3 | CO1 |
| | | **OR** | | | |
| Q.2 | a. | Starting from Schrodinger Time Independent wave equation, obtain the expressions for Energy Eigen values and normalized Eigen wave function for a particle in one dimensional infinite potential well. | 9 | L2 | CO1 |
| | b. | State and explain Heisenberg's uncertainty principle. Using the same, show the non-existence of electron inside the nucleus. | 6 | L2 | CO1 |
| | c. | An electron and a photon each have same de-Broglie wavelength of 10 Å. Find the kinetic energy of electron and energy of photon. | 5 | L3 | CO1 |
| | | **Module – 2** | | | |
| Q.3 | a. | Define superconductivity and critical temperature. Explain briefly SQUID and mention its any three applications. | 10 | L2 | CO2 |
| | b. | Mention the expression for internal field for one dimensional array of atoms in case of solid dielectrics. Derive Clausius Mossotti equation. | 6 | L2 | CO2 |
| | c. | Evaluate the probability of an electron occupying an energy level 0.02 eV above the Fermi level at 400 K. | 4 | L3 | CO2 |
| | | **OR** | | | |
| Q.4 | a. | Explain Electronic, Ionic and Orientation polarizations of dielectrics. Outline briefly the solid and liquid dielectrics with one example each. | 10 | L2 | CO2 |
| | b. | Give any four assumptions of quantum free electron theory. Mention the expression for electrical conductivity in metals and explain the symbols. | 6 | L2 | CO2 |
| | c. | Lead in the superconducting state has critical temperature of 6.2 K at zero magnetic field and a critical field of 0.064 $MAm^{-1}$ at 0 K. Determine the critical field at 4 K. | 4 | L3 | CO2 |
| | | **Module – 3** | | | |
| Q.5 | a. | Mention any four characteristics of LASER and explain three types of interaction of radiation with matter. | 10 | L2 | CO1 |

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|---|---|---|---|---|---|
| | **b.** | With a neat labelled block diagram, explain the application of optical fibers in point to point communication. | **6** | **L2** | **CO1** |
| | **c.** | A medium in thermal equilibrium at 300 K has two energy levels with wavelength separation 1 $\mu$m. Find the population densities ratio of upper and lower energy levels. | **4** | **L3** | **CO1** |
| | | **OR** | | | |
| **Q.6** | **a.** | Derive an expression for numerical aperture of an optical fiber. Discuss step-index single mode and multi mode optical fibers. | **10** | **L2** | **CO1** |
| | **b.** | Discuss the application of laser in laser range finder in Defence. | **6** | **L2** | **CO1** |
| | **c.** | The sum of refractive indices of core and cladding in a step index optical fiber is 3.12 and their difference is 0.08. The diameter of core is 50 $\mu$m. Find the V-number and number of modes that the fiber can support for propagation at the wavelength 594 nm. | **4** | **L3** | **CO1** |
| | | **Module – 4** | | | |
| **Q.7** | **a.** | Write Maxwell's equations in vacuum. Drive equation of electromagnetic waves using Maxwell's equation in free space. | **8** | **L2** | **CO3** |
| | **b.** | State and derive Gauss divergence theorem. Mention Stoke's theorem in mathematical form. | **7** | **L2** | **CO3** |
| | **c.** | Find the resonance frequency of an LCR series circuit with inductance = 0.5 henry, capacitance = 0.45 microfarad and resistance = 400 ohm. | **5** | **L3** | **CO5** |
| | | **OR** | | | |
| **Q.8** | **a.** | State and explain : Gauss law in magnetism, Ampere's circuital law and Biot-Savart's law. | **8** | **L2** | **CO3** |
| | **b.** | Discuss continuity equation. Derive an expression for displacement current. | **7** | **L2** | **CO3** |
| | **c.** | Find the wavelength of the semiconductor laser in the diffraction grating experiment when the angle of diffraction is 1.5 degree for the second order maximum. Given grating constant = $4.7\times10^{-5}$ per metre. | **5** | **L3** | **CO5** |
| | | **Module – 5** | | | |
| **Q.9** | **a.** | State and explain law of mass action for semiconductors. Derive the expression for Fermi energy interms of energy gap of intrinsic semiconductor. | **10** | **L2** | **CO4** |
| | **b.** | Describe the construction and working of semiconductor laser diode. | **6** | **L2** | **CO4** |
| | **c.** | The concentration of electrons at room temperature in an extrinsic semiconductor used in Hall experiment is $1.7\times10^{29}/m^3$. If a current of 100 A flows through the semiconducting strip of thickness 1 mm and the strength of magnetic field perpendicular to the strip is 3.6 wb/$m^2$, estimate the Hall coefficient and Hall voltage. | **4** | **L3** | **CO4** |
| | | **OR** | | | |
| **Q.10** | **a.** | What is Hall effect? Derive an expression for Hall voltage in terms of Hall coefficient. Mention any three applications of Hall effect. | **10** | **L2** | **CO4** |
| | **b.** | Explain Four probe method to determine resistivity of semiconductor. | **6** | **L2** | **CO4** |
| | **c.** | Mobilities of electrons and holes in a sample of intrinsic Germanium at 300 K are 0.36 $m^2V^{-1}s^{-1}$ and 0.14 $m^2V^{-1}s^{-1}$ respectively. If the resistivity of Ge is 2.5 $\Omega$m, compute the intrinsic carrier density. | **4** | **L3** | **CO4** |

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CBCS SCHEME

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BPHYE102/202

# First/Second Semester B.E./B.Tech. Degree Examination, Dec.2023/Jan.2024

## Applied Physics for EEE Stream

Time: 3 hrs. Max. Marks: 100

***Note:*** *1. Answer any FIVE full questions, choosing ONE full question from each module.*
*2. VTU Formula Hand Book is permitted.*
*3. M : Marks , L: Bloom's level , C: Course outcomes.*
*4. Speed of light $c = 3 \times 10^8$ m/s, $K = 1.38 \times 10^{-23}$ J/K, $h = 6.625 \times 10^{-34}$ JS, $g = 9.8$ m/s$^2$, $\epsilon_0 = 8.854 \times 10^{-12}$ F/m*

| | | Module – 1 | M | L | C |
|---|---|---|---|---|---|
| Q.1 | a. | State and explain Heisenberg's uncertainty principle and show that there is no existence of electrons in the nucleus of an atom. | 9 | L2 | CO1 |
| | b. | What is a wave function, probability density and normalization of wave function? | 7 | L2 | CO1 |
| | c. | Find the lowest energy of an electron confined to move in a one dimensional potential box of length 1A in electron volts. | 4 | L3 | CO1 |
| | | **OR** | | | |
| Q.2 | a. | Setup time Independent Schrodinger's wave equation for a particle in one dimension. | 7 | L2 | CO1 |
| | b. | Discuss the wave functions, probability densities and energy for a particle in a box by considering the ground state and first two excited states. | 9 | L2 | CO1 |
| | c. | Calculate the de-Broglie wavelength of an electron when it is accelerated to a potential of 5000 V. | 4 | L3 | CO1 |
| | | **Module – 2** | | | |
| Q.3 | a. | Mention any three assumptions of quantum free electron theory. Discuss the variation of Fermi factor with temperature and energy. | 9 | L2 | CO1 |
| | b. | Explain the construction and working of MAGLEV vehicle. | 6 | L2 | CO1 |
| | c. | An elemental solid dielectric material has polarizability of $7 \times 10^{-40}$ Fm$^2$. Assuming the internal field to be Lorentz field, calculate the dielectric constant for the material if the material has $3 \times 10^{28}$ atoms/m$^3$. | 5 | L3 | CO1 |
| | | **OR** | | | |
| Q.4 | a. | What is super conductivity? Describe Type-I and Type-II superconductors. | 7 | L2 | CO1 |
| | b. | What is dielectric polarization? Explain various types of polarization mechanism. | 8 | L2 | CO1 |
| | c. | Calculate the probability of an electron occupying an energy level 0.02 eV above the Fermi level at 200 K and 400 K in a material. | 5 | L3 | CO1 |
| | | **Module – 3** | | | |
| Q.5 | a. | Obtain an expression for energy density of radiation under thermal equilibrium conditions in terms of Einstein's coefficients. | 8 | L2 | CO2 |
| | b. | What is attenuation? Explain different types of attenuation in optical fibers. | 8 | L2 | CO2 |
| | c. | The average output power of laser source emitting a laser beam of wave length 6328 A is 5 mW. Find the number of photons emitted per second by the laser source. | 4 | L3 | CO2 |
| | | **OR** | | | |

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|---|---|---|---|---|---|
| **Q.6** | **a.** | What is numerical aperture? Obtain an expression for numerical aperture interms of refractive indices of core and cladding of an optical fiber. | **9** | **L2** | **CO2** |
| | **b.** | Describe the working of a laser printer. | **6** | **L2** | **CO2** |
| | **c.** | The attenuation of light in an optical fiber is estimated at 2.2 dB/km. What fractional initial intensity remains after 2 km and after 6 km. | **5** | **L3** | **CO2** |
| | | **Module – 4** | | | |
| **Q.7** | **a.** | State and prove Gauss Divergence theorem. | **7** | **L2** | **CO3** |
| | **b.** | Explain Faraday's laws of electromagnetic induction and amperes law. Express the same in point form. | **8** | **L2** | **CO3** |
| | **c.** | Determine the constant c such that the vector $\vec{A} = (x + ay)\hat{a}_x + (y + bz)\hat{a}_y + (x + cz)\hat{a}_z$ is solenoidal. | **5** | **L3** | **CO3** |
| | | **OR** | | | |
| **Q.8** | **a.** | Derive wave equation in terms of electric field using Maxwell's equations for free space. | **8** | **L2** | **CO3** |
| | **b.** | Discuss continuity equation. Derive the expression for displacement current. | **8** | **L2** | **CO3** |
| | **c.** | Calculate the curl of $\vec{A}$ given by $\vec{A} = (1 + yz^2)\hat{a}_x + xy^2\hat{a}_y + x^2y\hat{a}_z$. | **4** | **L3** | **CO3** |
| | | **Module – 5** | | | |
| **Q.9** | **a.** | Derive an expression for electrical conductivity in extrinsic and intrinsic semiconductors. | **8** | **L2** | **CO4** |
| | **b.** | Describe the construction and working of semiconductor laser with energy level diagram. | **8** | **L2** | **CO4** |
| | **c.** | The Hall coefficient of a specimen of a doped silicon is found to be $3.66 \times 10^{-4}$ $m^3/c$. The resistivity of the specimen is $9.93 \times 10^{-3}$ ohm-m. Find the mobility and charge carrier density assuming single carrier conduction. | **4** | **L3** | **CO4** |
| | | **OR** | | | |
| **Q.10** | **a.** | Explain Fermi level in an intrinsic semiconductor and derive the relation between Fermi energy and energy gap for an intrinsic semiconductor. | **9** | **L2** | **CO4** |
| | **b.** | Explain construction and working of photo diode. | **7** | **L2** | **CO5** |
| | **c.** | The resistivity of intrinsic germanium at 27°C is 0.47 ohm-meter. If the electron and hole mobilities are 0.38 $m^2/VS$ and 0.18 $m^2/VS$ respectively. Calculate the intrinsic carrier density. | **4** | **L3** | **CO4** |

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CBCS SCHEME

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BPHYS102/BPHYS202

# First/Second Semester B.E./B.Tech. Degree Examination, Dec.2023/Jan.2024
## Applied Physics for CSE Stream

Time: 3 hrs. Max. Marks: 100

***Note:*** 1. *Answer any FIVE full questions, choosing ONE full question from each module.*
2. *Draw neat sketches where ever necessary.*
3. *VTU Formula Hand Book is permitted.*
4. *M : Marks , L: Bloom's level , C: Course outcomes.*
5. *Constants: Speed of Light $C = 3 \times 10^8$ m/s, Boltzmam const. $K = 1.38 \times 10^{-23}$ J/K$^{-1}$, Planck's const $h = 6.625 \times 10^{-34}$ JS, Acceleration due to gravity $g = 9.8$m/s$^{-2}$, Permittivity of Free space $\epsilon_0 = 8.854 \times 10^{-12}$ Fm$^{-1}$*

| | | Module – 1 | M | L | C |
|---|---|---|---|---|---|
| Q.1 | a. | Define LASER and explain the interaction of radiation with matter for the induced absorption, spontaneous emission and stimulated emission. | 7 | L1 | CO1 |
| | b. | Discuss different types optical fibers based on modes of propagation and refractive index profile. | 9 | L2 | CO1 |
| | c. | Find attenuation in an optical fiber of length 500m, when a light signal of power 100mW emerges out of the fiber with a power of 90mW. | 4 | L3 | CO1 |
| | | **OR** | | | |
| Q.2 | a. | Obtain the expression for energy density of radiation using Einstein's co-efficient A and B and thus conclude $B_{12} = B_{21}$. | 9 | L2 | CO1 |
| | b. | Discuss point to point communication using optical fiber. | 6 | L2 | CO1 |
| | c. | In a diffraction grating experiment the LASER light undergoes second order diffraction for diffraction angle 1.48°. The grating constant $d = 5.05 \times 10^{-5}$ m and the distance between the grating and source is 0.60m, find the wavelength of LASER light. | 5 | L3 | CO5 |
| | | **Module – 2** | | | |
| Q.3 | a. | State and explain Heisenberg's uncertainty principle. Using the principle show that electron doesn't exist inside the nucleus. | 7 | L2 | CO2 |
| | b. | Set up Schrodinger's time independent wave equation in one dimension. | 8 | L2 | CO2 |
| | c. | A particle of mass 0.5 MeV/C$^2$ has kinetic energy 100 eV. Find its de-Broglie wavelength where 'C' is the velocity of light. | 5 | L3 | CO2 |
| | | **OR** | | | |
| Q.4 | a. | Find the Eigen values and Eigen functions for a particle in one dimensional infinite potential well. | 9 | L2 | CO2 |
| | b. | Discuss de-Broglie hypothesis. | 6 | L2 | CO2 |
| | c. | Calculate the energy of the first three states for an electron in one dimensional potential well of width 1A°. | 5 | L3 | CO2 |

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|---|---|---|---|---|---|
| | | **Module – 3** | | | |
| **Q.5** | **a.** | Explain the representation of qubit using Bloch sphere. | **6** | **L2** | **CO2** |
| | **b.** | Discuss CNOT gate, matrix representation and its operation on four different input states. | **6** | **L2** | **CO2** |
| | **c.** | A linear operator X operates such that $X\|0\rangle = \|1\rangle$ and $X\|1\rangle = \|0\rangle$. Find the matrix representation of X | **8** | **L3** | **CO2** |
| | | **OR** | | | |
| **Q.6** | **a.** | State the Pauli's metrics and apply Pauli matrices on the states $\|0\rangle$ and $\|1\rangle$ states. | **8** | **L3** | **CO2** |
| | **b.** | Elucidate the differences between classical and quantum computing. | **6** | **L2** | **CO2** |
| | **c.** | Explain matrix representation of 0 and 1 states and apply identify operator I to $\|0\rangle$ and $\|1\rangle$ states. | **6** | **L3** | **CO2** |
| | | **Module – 4** | | | |
| **Q.7** | **a.** | Enumerate the failures of Classical Free Electron [CFET] Theory and mention the assumptions of Quantum Free Electron Theory [QFET] | **7** | **L2** | **CO3** |
| | **b.** | Describe Meissner's effect. Distinguish between Type I and Type II super conductors. | **8** | **L2** | **CO3** |
| | **c.** | Lead has a superconducting transition temperature of 7.26K. If initial field at 0K is $50 \times 10^3 Am^{-1}$, calculate the critical field at 6K. | **5** | **L3** | **CO3** |
| | | **OR** | | | |
| **Q.8** | **a.** | Define Fermi factor. Discuss the variation of Fermi factor with temperature and energy. | **7** | **L2** | **CO3** |
| | **b.** | Explain the phenomenon of super conductivity. Discuss qualitatively BCS theory of super conductivity. | **8** | **L2** | **CO3** |
| | **c.** | Calculate the probability of occupation of an energy level 0.02eV above Fermi level at temperature 200K. | **5** | **L3** | **CO3** |
| | | **Module – 5** | | | |
| **Q.9** | **a.** | Discuss timing in linear motion, uniform motion, slow in and slow out. | **8** | **L2** | **CO4** |
| | **b.** | Enumerate the difference between inferential and descriptive statistics. | **6** | **L2** | **CO4** |
| | **c.** | In an optical fiber experiment, the light passing through the fiber, made a spot diameter of 8mm on the screen. The distance between the end of the optical fiber cable and the screen is 0.031m. Calculate the angle of acceptance and numerical aperture of given optical fiber. | **6** | **L3** | **CO5** |
| | | **OR** | | | |
| **Q.10** | **a.** | Describe Jumping and parts of Jump. | **8** | **L2** | **CO4** |
| | **b.** | Discuss the salient features of Normal distribution using Bell curves. | **7** | **L2** | **CO4** |
| | **c.** | While animating speeding up car animation, the total distance covered over 6 frames is 25m. Calculate the base distance. | **5** | **L3** | **CO4** |

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CBCS SCHEME

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18PHY12/22

# First/Second Semester B.E. Degree Examination, Dec.2023/Jan.2024
## Engineering Physics

Time: 3 hrs. Max. Marks: 100

**Note:** ***Answer any FIVE full questions, choosing ONE full question from each module.***



### Module-1

1 a. Define simple harmonic motion and mention its characteristics. Derive expression for effective spring constant for two springs in series and parallel. **(09 Marks)**

b. Distinguish between subsonic supersonic, Transonic and hypersonic waves. **(06 Marks)**

c. The distance between two pressure sensors in a shock tube is 100mm. The time take by the shock wave to travel this distance is 0.2ms. If the velocity of sound under the same condition is $330ms^{-1}$ find the mach number of shock waves. **(05 Marks)**

**OR**

2 a. What are damped and forced vibrations? Give examples write a note on sharpness of resonance. **(08 Marks)**

b. What are shock waves? Describe construction and working of Reddy's shock tube. **(08 Marks)**

c. A body having a mass 4gm executes simple harmonic motion. The force acting on the body, when the displacement is 8cm is 24gm.wt. Find the period if the maximum velocity is 5m/s, find the amplitude and maximum acceleration ($g = 9.8\ ms^{-2}$). **(04 Marks)**

### Module-2

3 a. State and explain Hook's law, and different elastic module. **(08 Marks)**

b. What is torsinal pendulum? Derive an expression for couple per unit twist of a solid cylinder **(08 Marks)**

c. Two solid cylinders of the save material having length $\ell$, $2\ell$ and r, 2r respectively are joined coaxially, under a coupled applied between the free ends, the shorter cylinder shows a twist of 30°. Calculate the twist of the laser cylinder. **(04 Marks)**

**OR**

4 a. Define neural surface of a beam. Obtain an expression for bending moment of a rectangular beam. **(08 Marks)**

b. Derive the relation between Young's modulus, bulk modulus and Passions ratio. Discuss the limiting values of $\sigma$. **(08 Marks)**

c. A steel wire of 1mm radius is bent to form a circle of 10cm radius. What is the bending moment and the maximum stress, if Young's modulus = $2 \times 10^{11} N\text{-}m^{-2}$ **(04 Marks)**

### Module-3

5 a. Define gradient, divergence and Carl. Derive Gauss's divergence theorem. **(08 Marks)**

b. What is V-number? Explain three different types of optical fibre with neat diagram. **(08 Marks)**

c. An optical fibre of 600m long has input power of 120mW which emerges out with power of 90mW. Find attenuation in the fiber. **(04 Marks)**

**OR**

6 a. Define attenuation angle acceptance. Derive the condition for propagation of light through an optical fiber. **(08 Marks)**

b. List the four Maxwell's equations for time varying conditions. Explain the conditions for elliptical polarization of electromagnetic waves. **(08 Marks)**

c. Find the divergence of the vector field $\vec{A}$ given by

$\vec{A} = 6x^2\hat{a}_x + 3xy^2\hat{a}_y + xyz^3\hat{a}_z$ at a point P(1, 3, 6). **(04 Marks)**

## Module-4

7 a. State and explain Heisenberg's concentrating principle. Show that no electrons present inside the nucleus. **(09 Marks)**

b. Define population inversion. Explain construction and working of carbon dioxide laser with neat diagrams. **(07 Marks)**

c. An electron is bound is one dimensional potential well of width 0.12nm. Find the every values in the ground stets and first exacted states electron volt (eV). **(04 Marks)**

**OR**

8 a. Obtain an expression for energy density of radiation under equilibrium condition in terms of Einstein's coefficients. **(08 Marks)**

b. Mention the properties of wave function. Set up one dimensional time independent wave equation. **(08 Marks)**

c. Find the ratio of population of two energy levels in a laser if the transition between them produces light of wavelength 694.3nm. Assume the ambient temperature to be 27°C. **(04 Marks)**

## Module-5

9 a. Explain success of quantum free electron theory and discuss the variation of Fermi factor with temperature. **(08 Marks)**

b. What is internal field? Derive Clausius – Morsotti equation. **(08 Marks)**

c. The resistivity of intrinsic Germanium at 25°C is equal to 0.47 ohm-meter. Assuming electron and hole mobilities as 0.38 and $0.18 m^2 v^{-1}s^{-1}$ respectively, calculate the intrinsic carrier density. **(04 Marks)**

**OR**

10 a. What is Hall effect? Explain an expression for electrical conductivity of a semiconductor. **(08 Marks)**

b. Explain density of states, polar and non-polar dielectrics **(08 Marks)**

c. The hall coefficient of a specimen is $-3.66 \times 10^{-4} m^3 c^{-1}$, its resistivity is $8.93 \times 10^{-3}$. Find mobility and density of charge carriers. **(04 Marks)**

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CBCS SCHEME

10

USN | | | | | | | | | | |

21PHY12/22

# First/Second Semester B.E. Degree Examination, Dec.2023/Jan.2024
## Engineering Physics

Time: 3 hrs. Max. Marks: 100

**Note:** *1. Answer any FIVE full questions, choosing ONE full question from each module.*

*2. Physical constants : Plank's constant= $6.625 \times 10^{-34}$ J-S, Boltzmann's constant = $1.38 \times 10^{-23}$ J/K, $e = 1.6 \times 10^{-19}$ C, $C = 3 \times 10^{8}$ m/s, $g = 9.8$ m/sec$^2$, $m_e = 9.1 \times 10^{-31}$ Kg*



### Module-1

1 a. What are damped oscillations? Deduce the differential equation for damped oscillations arrive at the solutions give graphical representations of all the three cases. **(08 Marks)**

b. What are shock waves? With a neat diagram, explain the construction and working of Reddy shock tube. **(08 Marks)**

c. A mass of 0.8Kg causes an extension of 0.06m in a spring and mass system which is set for oscillations. Calculate force constant of the spring and time period of oscillations. **(04 Marks)**

**OR**

2 a. Discuss the theory of forced vibrations and hence obtain the expression for amplitude by solving the differential equation of forced oscillation. **(08 Marks)**

b. What is spring constant? Mention its significance. Deduce the expression for equivalent spring constants, when two springs are connected in series and parallel. **(08 Marks)**

c. While using a Reddy shock tube, it is found that the time taken to travel between two pressure sensors is 15μs. If the distance between two sensors is 10mm, find the Mach number. Assume that the velocity of sound in the medium is 340m/sec. **(04 Marks)**

### Module-2

3 a. State and explain Plank's law of radiation. Explain how it changes to Wein's law and Rayleigh-Jeans law. **(08 Marks)**

b. Mention the properties of wave function. Deduce Schrodinger's time independent wave equation. **(08 Marks)**

c. The inherent uncertainty in the measurement of the time spent by iridium – 191 nuclei in the excited state is found to be $2.5 \times 10^{-10}$ sec. Calculate the uncertainty that results in its energy in the excited state. **(04 Marks)**

**OR**

4 a. Solve the Schrodinger wave equation for the case of a particle in an infinite potential well and discuss its solutions? **(08 Marks)**

b. Explain the spectrum of black body radiation. Prove that an electron does not exist inside the nucleus using Heisenberg's uncertainty principle. **(08 Marks)**

c. Compute momentum and de-Broglie wavelength associated with an electron moving with kinetic energy 2KeV. **(04 Marks)**

## Module-3

5 a. Derive an expression for energy density of incident radiation interms of Einstein's coefficients. **(08 Marks)**

b. What is angle of acceptance and numerical aperture of an optical fiber? Deduce the expression for Numerical aperture of optic fiber and mention the condition for ray propagation. **(08 Marks)**

c. Find the attenuation in an optic fiber of length 600m when a light of power 150mW incident and emerges out with 140mW power. **(04 Marks)**

**OR**

6 a. Describe construction and working of $CO_2$ laser with a neat energy level diagram. **(08 Marks)**

b. Explain different modes of propagation in optic fiber. Explain the optic fiber as temperature sensor. **(08 Marks)**

c. Ratio of population of two energy levels is $1.06 \times 10^{-30}$. Find the wavelength of light emitted by spontaneous emission at 310K. **(04 Marks)**

## Module-4

7 a. Explain Hall effect. Deduce the expression for Hall voltage and Hall coefficient. **(08 Marks)**

b. Explain different polarization mechanisms in dielectrics. Briefly explain internal fields in solid dielectrics. **(08 Marks)**

c. The resistivity of intrinsic germanium at 27°C is equal to 0.47Ωm. Assuming electron and hole mobilities as 0.36 and $0.17 m^2V^{-1}S^{-1}$ respectively, calculate intrinsic carrier density. **(04 Marks)**

**OR**

8 a. Derive the expression for electrical conductivity in metals using quantum free electron theory. Explain any two success of quantum free theory. **(08 Marks)**

b. State and explain Fremi energy? Deduce the expression for Fermi energy at zero Kelvin **(08 Marks)**

c. Find the temperature at which there is 1% probability that a state with an energy 0.5eV above Fermi energy is occupied. **(04 Marks)**

## Module-5

9 a. With a neat diagram, explain the principle, construction and working of Atomic force microscope. **(08 Marks)**

b. Explain the principle, construction and working of transmission electron microscope using a neat labelled diagram. **(08 Marks)**

c. Write a note on nano-composites. Give two examples. **(04 Marks)**

**OR**

10 a. Give the principle instruction and working of X-ray diffraction meter. **(08 Marks)**

b. Explain the principle, construction and working of scanning electron microscope with a neat labelled diagram. **(08 Marks)**

c. Determine the crystal size ; given, the wavelength of X-rays 10nms, the peak width of 0.5° and peak position of 25° and K = 0.94 for a cubic crystal? **(04 Marks)**

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CBCS SCHEME

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BPHYE102

# First Semester B.E./B.Tech. Degree Examination, Jan./Feb. 2023
## Applied Physics for EEE Stream

Time: 3 hrs. Max. Marks: 100

***Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.***
***2. VTU Formula Hand Book is permitted.***
***3. M : Marks , L: Bloom's level , C: Course outcomes.***

| | | Module – 1 | M | L | C |
|---|---|---|---|---|---|
| Q.1 | a. | Define Wave function, then setup time – independent one dimensional Schrodinger's wave equation. | 8 | L2 | CO1 |
| | b. | State Heisenberg's uncertainty principle and show that a free electron cannot exist within the nucleus of an atom. | 7 | L2 | CO1 |
| | c. | Calculate the de Broglic wavelength associated with an electron with a kinetic energy of 1.5ev. | 5 | L2 | CO1 |
| | | **OR** | | | |
| Q.2 | a. | Derive Eigen function equation for a particle in one – dimensional potential wall of infinite height. | 8 | L2 | CO1 |
| | b. | Explain de Broglic Hypothesis. Derive the expression for de Broglic wavelength and mention different forms of de Broglic wavelength. | 7 | L2 | CO1 |
| | c. | In a measurement of position and momentum that involved an uncertainty of 0.003% , the speed of an electron was found to be 800 m/s. Calculate the corresponding uncertainty that arises in determining its position. | 5 | L3 | CO1 |
| | | **Module – 2** | | | |
| Q.3 | a. | What is Fermi factor and explain the variation of Fermi factor with respect to temperature and energy. | 8 | L2 | CO2 |
| | b. | Define Internal field and derive Clausius - Mossotti relation. | 7 | L2 | CO2 |
| | c. | Solve the polarization produced in crystal by an electric field of strength 500 $vm^{-1}$, If it has a dielectric constant of 6. | 5 | L3 | CO2 |
| | | **OR** | | | |
| Q.4 | a. | Classify and explain Type – I and Type – II superconductors. | 8 | L2 | CO2 |
| | b. | Define Dielectric Polarization and explain different types of Electrical polarization mechanisms. | 7 | L2 | CO2 |
| | c. | Calculate the probability of an electron occupying and energy level 0.02ev above the Fermi level at 200K and 400K. | 5 | L3 | CO2 |
| | | **Module – 3** | | | |
| Q.5 | a. | Define Spontaneous Emission and Stimulates Emission. Derive the expression for energy density of radiation at equilibrium in terms of Einstein's coefficients. | 8 | L2 | CO1 |
| | b. | Describe different types of optical fibres , with neat diagram. | 7 | L2 | CO1 |
| | c. | In a optical fiber experiment, the distance between the fiber and screen is 45mm and radius of the spot is 6mm. Calculate the angle of acceptance and numerical aperature of an optical fiber. | 5 | L3 | CO5 |

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|---|---|---|---|---|---|
| | | **OR** | | | |
| **Q.6** | **a.** | Define Numerical aperature and derive the expression for numerical aperature of an optical fiber and mention the condition for ray propagation in optical fiber. | **8** | **L2** | **CO1** |
| | **b.** | With neat diagrams, explain the construction and working of $CO_2$ Laser. | **7** | **L2** | **CO1** |
| | **c.** | The average output power at Laser source emitting a Laser Beam of wavelength 632.8mm is 5mw. Find the number of protons emitted per second by the Laser source. | **5** | **L3** | **CO1** |
| | | **Module – 4** | | | |
| **Q.7** | **a.** | State and explain Gauss Divergence theorem and mention the Stoke's theorem. | **8** | **L2** | **CO3** |
| | **b.** | Derive Wave equation in terms of electric field using Maxwell's equation for free space. | **7** | **L2** | **CO3** |
| | **c.** | A circular coil of wire consisting of 100 turns. Each of radius 8cm carries a current of 0.4A. What is the magnitude of the magnetic field at a point 20cm from the wire? | **5** | **L3** | **CO5** |
| | | **OR** | | | |
| **Q.8** | **a.** | What is Displacement current? Derive the expression for displacement current. | **8** | **L2** | **CO3** |
| | **b.** | State Biot – Savart's law and list four Maxwell's equations in differential form. | **7** | **L2** | **CO3** |
| | **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. | **5** | **L3** | **CO3** |
| | | **Module – 5** | | | |
| **Q.9** | **a.** | What is Hall Effect? Obtain the expression for Hall coefficient and express Hall Voltage in terms of Hall coefficient. | **8** | **L2** | **CO4** |
| | **b.** | Explain Construction and working of Photodiode and mention its applications. | **7** | **L2** | **CO4** |
| | **c.** | In a Plank's constant experiment, the knee voltage of a given Red LED emitting light of wavelength 650nm is 1.908V. Calculate the Plank's constant. | **5** | **L3** | **CO5** |
| | | **OR** | | | |
| **Q.10** | **a.** | Explain Construction and working of an Semiconductor Laser and mention its applications. | **8** | **L2** | **CO4** |
| | **b.** | Mention the expression for Hole and Electron concentration in a intrinsic semiconductor and derive the expression for electrical conductivity of a semiconductor. | **7** | **L2** | **CO4** |
| | **c.** | The Hall coefficient of a material is $-3.68 \times 10^{-5}\ m^3/C$. What is the type of charge carriers? Also calculate the carrier concentration. | **5** | **L3** | **CO4** |

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CBCS SCHEME

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21PHY12/22

# First/Second Semester B.E. Degree Examination, Jan./Feb. 2023
## Engineering Physics

Time: 3 hrs. Max. Marks: 100

**Note:** *1. Answer any FIVE full questions, choosing ONE full question from each module.*
*2. Constants : Speed of light "C" = $3 \times 10^8 ms^{-1}$, Boltzmann constant "K" = $1.38 \times 10^{-23} JK^{-1}$, Planck's constant "h" = $6.625 \times 10^{-34} JS$, Acceleration due to gravity "g" = $9.8 MS^{-2}$ permittivity of free space. "$\varepsilon_0$" = $8.854 \times 10^{-12} FM^{-1}$.*



### Module-1

1 a. What are damped oscillations? Discuss the theory of damped oscillations and derive general solution of damped oscillations. **(10 Marks)**
b. Discuss the classification of waves based on Mach number. **(06 Marks)**
c. For a particle executing SHM, the acceleration is found to be $15 cm/s^2$ when it is at 3cm from its mean position. Calculate the period of oscillation. **(04 Marks)**

**OR**

2 a. Describe the construction and working of Reddy's shock tube. Explain any four applications of shockwaves. **(10 Marks)**
b. Define simple harmonic motion and derive differential equation of SHM. **(06 Marks)**
c. The time taken to travel between two sensors of the shock tube is 195 μs. If the distance between the sensors is 0.1m, find the Mach number of shockwaves produced. **(04 Marks)**

### Module-2

3 a. Deduce Wein's equation and Rayleigh Jeans equation from Planck's equation and show that Planck's theory explains complete black body spectrum. **(08 Marks)**
b. State and explain Heisenberg's uncertainty principle and apply it to prove that free electron cannot exist inside the nucleus of atom. **(08 Marks)**
c. Calculate the de-Broglie wavelength associated with an electron accelerated to a potential 2KV. Also calculate the velocity of electron. Assume $m = 9.1 \times 10^{-31} kg$. **(04 Marks)**

**OR**

4 a. Apply Schrodinger equation for particle in one dimensional potential well of infinite height and derive expression for energy eigen value and eigen function. **(10 Marks)**
b. Discuss spectral distribution of energy in black body radiation spectrum and hence explain Wein's displacement law. **(06 Marks)**
c. An electron is bound in a one dimensional potential well of width 1Å but infinite height. Find its energy eigen values in the ground state and first two excited states. **(04 Marks)**

### Module-3

5 a. Explain induced absorption, spontaneous and stimulated emission. Obtain an expression for density of states using Einstein's coefficients. **(08 Marks)**
b. Define numerical aperture and derive an expression for numerical aperture. **(08 Marks)**
c. The ratio of population of two energy levels is $1.059 \times 10^{-30}$. Find the wavelength of laser light emitted due to transition between these energy levels at 330K. **(04 Marks)**

**OR**

6 a. What is attenuation in an optical fiber? Describe the different types of attenuation. **(09 Marks)**

b. Describe the construction and working of semiconductor Laser with suitable figures. **(07 Marks)**

c. In an optical fiber of core diameter 50μm the refractive indices of core and cladding are respectively 1.45 and 1.40. If the wavelength of the light passing through the fiber is 820nm find the numerical aperture, V-number and number of modes of propagation. **(04 Marks)**

## Module-4

7 a. Mention the assumptions and failures of classical free electron theory. **(09 Marks)**

b. Derive Clausius – Mosotti equation. **(07 Marks)**

c. Find the temperature at which there is 1% probability of occupation of an energy level 0.5eV above Fermi energy. **(04 Marks)**

**OR**

8 a. What is Hall effect? Obtain an expression for Hall coefficient. **(09 Marks)**

b. Discuss the variation of Fermi factor with temperature with graph. **(07 Marks)**

c. A dielectric material of dielectric constant 6 is subjected to an electric field 500/mm. Calculate the polarization produced. **(04 Marks)**

## Module-5

9 a. Write the properties and applications of nano composites. **(08 Marks)**

b. Describe the principle, construction and working of scanning electron microscope. **(08 Marks)**

c. Determine the crystallite size for a cubic crystal (K = 0.94) if the wave length of X-rays used is 10nm, the peak width is 0.50 for a peak positioned at 25°. **(04 Marks)**

**OR**

10 a. With a neat sketch explain the construction and working principle of Atomic Force Microscope. **(08 Marks)**

b. Describe the construction and mechanism of X-ray photoelectron spectroscopy. **(08 Marks)**

c. X-rays are diffracted at 30° from a crystal of interplanar spacing 0.187nm. If it is a second order diffraction, calculate the wavelength of X-rays. **(04 Marks)**

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MAKE-UP EXAM

USN | | | | | | | | | | |

BPHYS102/202

# First/Second Semester B.E./B.Tech. Degree Examination, Nov./Dec. 2023
## Applied Physics for CSE Stream

Time: 3 hrs. Max. Marks: 100

***Note:*** **1.** ***Answer any FIVE full questions, choosing ONE full question from each module.***
**2.** ***VTU Formula Hand Book is permitted.***
**3.** ***M : Marks , L: Bloom's level , C: Course outcomes.***
**4.** ***Physical constants: Plank's constant, $h = 6.625 \times 10^{-34}$ J-S; Speed of light, $c = 3 \times 10^{8}$ $ms^{-1}$; Mass of electron, $m = 9.1 \times 10^{-31}$ kg; Charge of electron, $e = 1.6 \times 10^{-19}$ C; Boltzmann constant, $k = 1.38 \times 10^{-23}$ $JK^{-1}$; Acceleration due to gravity, $g = 9.8$ $ms^{-2}$.***

| | | Module – 1 | M | L | C |
|---|---|---|---|---|---|
| Q.1 | a. | Obtain the expression for energy density of radiation under thermal equilibrium condition interms of Einstein's co-efficient. | 09 | L2 | CO1 |
| | b. | Explain the different types of optical fibers with suitable diagrams. | 06 | L2 | CO1 |
| | c. | An optical fiber of length 2 km has input power of 200 mW, which emerges out with power of 160 mW. Calculate the attenuation co-efficient of the fiber. | 05 | L3 | CO1 |
| | | **OR** | | | |
| Q.2 | a. | Describe the construction, principle and working of a semiconductor LASER with neat diagrams. | 07 | L2 | CO1 |
| | b. | Define numerical aperture and acceptance angle. Obtain an expression for numerical aperture interms of refractive indices of core, cladding and surrounding medium. | 08 | L2 | CO1 |
| | c. | In diffraction grating experiment the LASER light undergoes first order diffraction with diffracting angle 23.86°. The grating constant is $1.66 \times 10^{-6}$ $m^{-1}$. Calculate the wavelength of LASER source. | 05 | L3 | CO5 |
| | | **Module – 2** | | | |
| Q.3 | a. | State Heisenberg's uncertainty principle. Using this principle, prove that the electron does not exists inside the nucleus. | 08 | L2 | CO2 |
| | b. | Set up one dimensional time-independent Schrodinger wave equation. | 08 | L2 | CO2 |
| | c. | An electron is bound in one dimensional infinite potential well of width 0.12 nm. Find the energy value and de-Broglie wavelength in first excited level. | 04 | L3 | CO2 |
| | | **OR** | | | |
| Q.4 | a. | State and explain de-Broglie's hypothesis and derive the expression for de-Broglie wavelength by analogy. | 06 | L2 | CO2 |
| | b. | Derive the expression for energy eigen functions and eigen values for a particle in one dimensional infinite potential well. | 10 | L2 | CO2 |
| | c. | Estimate the potential difference through which an electron is needed to be accelerated so that its de-Broglie wavelength becomes equal to 20 $\mathring{A}$. | 04 | L3 | CO2 |
| | | **Module – 3** | | | |
| Q.5 | a. | Define single and two qubits. Explain the block sphere representation of qubit. | 08 | L2 | CO2 |
| | b. | Explain the controlled NOT gate (CNOT gate) with four different input states with the truth table. | 08 | L2 | CO2 |
| | c. | Show that S - gate can be formed by connecting two T – gates in series. | 04 | L3 | CO2 |
| | | **OR** | | | |

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|---|---|---|---|---|---|
| **Q.6** | **a.** | Mention the Pauli's matrices. Discuss the operations of Pauli's matrices on $\|0>$ and $\|1>$ states. | **10** | **L2** | **CO2** |
| | **b.** | Explain the operations of phase gate [S – gate] with $\|0>$ and $\|1>$ states with truth table. Mention its matrix representation. | **06** | **L2** | **CO2** |
| | **c.** | A linear operator X operates such that $X\|0> = \|1>$ and $X\|1> = \|0>$. Find the matrix representation of the operator X. | **04** | **L3** | **CO2** |
| | | **Module – 4** | | | |
| **Q.7** | **a.** | What is Meissner effect? Explain Type I [Soft] and Type II [Hard] super conductors. | **08** | **L2** | **CO3** |
| | **b.** | What is Fermi factor? Discuss the variation of Fermi factor with temperature and energy. | **08** | **L2** | **CO3** |
| | **c.** | Superconducting tin has a critical magnetic field of 0.0217 T at 2K. If the critical temperature for superconducting transition for tin is 3.7K, find the critical magnetic field at 3K. | **04** | **L3** | **CO3** |
| | | **OR** | | | |
| **Q.8** | **a.** | Define critical temperature and critical magnetic field. Explain briefly BCS theory of superconductivity. | **08** | **L2** | **CO3** |
| | **b.** | Enumerate the failures of classical free electron theory and mention the assumptions of quantum free electron theory. | **08** | **L2** | **CO3** |
| | **c.** | The Fermi level in potassium is 2.1 eV. What is the energy of the energy level for which the probability of occupation at 300 K is 0.98? | **04** | **L3** | **CO3** |
| | | **Module – 5** | | | |
| **Q.9** | **a.** | Explain the odd rule with odd rule multipliers with suitable examples. | **08** | **L2** | **CO4** |
| | **b.** | Explain Poisson distribution and probability mass function with example. | **07** | **L2** | **CO4** |
| | **c.** | In case of animating a jump, the push height is 0.5m and jump magnification is 5. Calculate the jump height and push acceleration. | **05** | **L3** | **CO4** |
| | | **OR** | | | |
| **Q.10** | **a.** | Discuss slow in and slow out with neat diagrams. | **08** | **L2** | **CO4** |
| | **b.** | Write a note on Monte-Carlo method and discuss the determination of the value of $\pi$ using Monte-Carlo method. | **07** | **L2** | **CO4** |
| | **c.** | In an optical fiber experiment the LASER light propagating through optical made a spot diameter of 21 mm on the screen. When the distance between the end of the fiber and the screen is 31 mm, calculate the acceptance angle and numerical aperture. | **05** | **L3** | **CO5** |

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MAKE-UP EXAM

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BPHYE102/202

# First/Second Semester B.E./B.Tech. Degree Examination, Nov./Dec. 2023
## Applied Physics for EEE Stream

Time: 3 hrs. Max. Marks: 100

***Note:*** **1.** ***Answer any FIVE full questions, choosing ONE full question from each module.***
**2.** ***VTU Formula Hand Book is permitted.***
**3.** ***M : Marks , L: Bloom's level , C: Course outcomes.***

| | | Module – 1 | M | L | C |
|---|---|---|---|---|---|
| Q.1 | a. | State Heisenberg's uncertainty principle. Show that an electron does not exist inside the nucleus on the basis of Heisenberg's uncertainty principle. | 7 | L2 | CO1 |
| | b. | Starting from Schrodinger's time independent wave equation, derive the expression for energy eigen value and eigen function for an electron in one dimensional potential well of infinite height. | 8 | L2 | CO1 |
| | c. | A particle of mass 0.5 MeV/$c^2$ has kinetic energy 100eV. Find its de Broglie wavelength, where C is the velocity of light. | 5 | L3 | CO1 |
| | | **OR** | | | |
| Q.2 | a. | Set up time independent Schrödinger wave equation for a free particle in one dimension. | 7 | L2 | CO1 |
| | b. | Explain probability density and normalization. Give the physical significance of a wave function. | 8 | L2 | CO1 |
| | c. | In a measurement that involved an inherent uncertainty of 0.003%, the speed of an electron was found to be 800m/s. Calculate the corresponding uncertainty involved in determining its position. | 5 | L3 | CO1 |
| | | **Module – 2** | | | |
| Q.3 | a. | Explain polarization of dielectric. Discuss the mechanism of different types of polarization. | 9 | L2 | CO1 |
| | b. | Describe the type I and type II superconductors. | 6 | L2 | CO1 |
| | c. | Find the temperature at which there is 1% probability that a state with an energy 0.5eV above Fermi energy is occupied. | 5 | L3 | CO1 |
| | | **OR** | | | |
| Q.4 | a. | Mention any two assumption of quantum fee theory? Discuss the probability of occupation of various energy states by electron on temperature on the basis of Fermi factor. | 9 | L2 | CO1 |
| | b. | Explain the construction and working of Maglev vehicles. | 6 | L2 | CO1 |

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|---|---|---|---|---|---|
| | c. | The dielectric constant of Helium gas at NTP is 1.0000684. Calculate the electronic polarizability of the atoms if Helium gas contains $2.7 \times 10^{25}$ atoms/$m^3$ and kept in an electric field of $3 \times 10^4$V/m. | 5 | L3 | CO1 |
| | | **Module – 3** | | | |
| Q.5 | a. | Obtain an expression for energy density of radiation under thermal equilibrium condition in terms of Einstein's co-efficient. | 8 | L2 | CO2 |
| | b. | What is attenuation? Discuss different types of attenuation in optical fiber. | 7 | L2 | CO2 |
| | c. | The ratio of population of upper to lower energy levels is $1.059 \times 10^{-30}$. Find the wave length of light emitted by spontaneous emission at 300K. | 5 | L3 | CO2 |
| | | **OR** | | | |
| Q.6 | a. | Define Numerical aperture. Obtain an expression for numerical aperture in an optical fiber. | 8 | L2 | CO2 |
| | b. | Describe the principle, construction and working of carbon dioxide laser with energy level diagram. | 7 | L2 | CO2 |
| | c. | In a step index optical fiber with a core diameter of 60μm and core and cladding refractive indices as 1.5 and 1.48 respectively. When the wavelength of 850nm is propagating through it. Calculate the numerical aperture, fractional index change, V-parameter and number of modes in the fiber. | 5 | L3 | CO2 |
| | | **Module – 4** | | | |
| Q.7 | a. | Discuss about continuity equation. Derive the expression for displacement current. | 8 | L2 | CO3 |
| | b. | Explain Faraday's law of Electromagnetic induction, Amperes law and express the same in point form. | 7 | L2 | CO3 |
| | c. | Determine the constant 'C' such that, the vector $\vec{A} = (x + ay)\hat{a}_x + (y + bz)\hat{a}_y + (x + cz)\hat{a}_z$ is solenoidal. | 5 | L3 | CO3 |
| | | **OR** | | | |
| Q.8 | a. | Derive wave equation for electromagnetic waves in vacuum in terms of electric field using Maxwell's equation. | 8 | L2 | CO3 |
| | b. | What are vector operator $\nabla$ and explain the concept of divergence, gradient and curl. | 7 | L2 | CO3 |
| | c. | Calculate the curl of $\vec{A}$, given $\vec{A} = (1 + yz^2)\hat{a}_x + xy^2\hat{a}_y + x^2y\hat{a}_z$ | 5 | L3 | CO3 |

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|---|---|---|---|---|---|
| | | **Module – 5** | | | |
| **Q.9** | **a.** | Discuss the law of mass action. Establish relation between Fermi energy and energy gap for an intrinsic semiconductor. | **8** | **L2** | **CO4** |
| | **b.** | Define Hall voltage and Hall field? Obtain expression for Hall voltage in term of Hall co-efficient. | **7** | **L2** | **CO4** |
| | **c.** | The resistivity of intrinsic germanium at 27°C is equal to 0.47 ohm-meter. Assuming electron and hole mobilities as $0.38 m^2V^{-1}s^{-1}$ and $0.18 m^2V^{-1}S^{-1}$ respectively. Calculate the intrinsic carrier density. | **5** | **L3** | **CO4** |
| | | **OR** | | | |
| **Q.10** | **a.** | Derive an expression for electrical conductivity in extrinsic and intrinsic semiconductor. | **8** | **L2** | **CO4** |
| | **b.** | Explain the construction and working of photo transistor and also mention any two applications. | **7** | **L2** | **CO4** |
| | **c.** | In diffraction gravity experiment the laser light undergoes second order diffraction for diffraction angle 1.48°. The grating constant $d = 5.05 \times 10^{-5}$m and the distance between the grating and screen is 0.60m. Calculate the wavelength of laser source. | **5** | **L3** | **CO5** |

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CBCS SCHEME

USN | | | | | | | | | | |

18PHY12/22

# First/Second Semester B.E. Degree Examination, July/August 2021
## Engineering Physics

Time: 3 hrs. Max. Marks: 100

**Note : 1.** ***Answer any FIVE full questions.***

**2.** ***Physical constants : $C = 3 \times 10^8$ m/s ; $h = 6.63 \times 10^{-34}$ JS ; $g = 9.8$ m/s$^2$ ; $\in_O = 8.856 \times 10^{-12}$ F/m ; $M = 9.11 \times 10^{-31}$ kg ; $e = 1.6 \times 10^{-19}$C ; $N_A = 6.02 \times 10^{26}$/K mole ; $K = 1.38 \times 10^{-23}$J/K***

1 a. Define Simple Harmonic motion. Derive the equation of motion for Simple Harmonic motion. Explain how complex notation is used in Simple Harmonic motion. **(10 Marks)**

b. Define Shock waves. Mention its applications. **(06 Marks)**

c. A mass 0.5kg causes an extension 0.03m in a spring and the system is set for oscillations. Find force constant of the spring, angular frequency and period of resulting oscillations. **(04 Marks)**

2 a. What are Damped Oscillations? Give the theory of damped oscillations and discuss the case of over damping. **(10 Marks)**

b. Describe Hand Operated Reddy Shock tube with the help of diagram. **(06 Marks)**

c. A free particle is executing Simple Harmonic motion in straight line. The maximum velocity it attains during any oscillation is 62.8m/s. Find the frequency of oscillation if its amplitude is 0.5m. **(04 Marks)**

3 a. Define Young's modulus, Rigidity modulus and Poisson's ratio. Derive the relation between them. **(10 Marks)**

b. Describe Strain softening and Strain hardening. **(06 Marks)**

c. Calculate the force required to produce an extension of 1mm in steel wire of length 2m and diameter 1mm. If given $Y = 2 \times 10^{11}$ N/m$^2$. **(04 Marks)**

4 a. State Hook's law. Derive an expression for Couple required to produce unit twist in a uniform cylindrical rod fixed at one end and the Couple being applied at the other end. **(08 Marks)**

b. What is Torsional Pendulum? Give the expression for period of oscillation and write its applications. **(06 Marks)**

c. A solid lead sphere of radius 10.3m is subjected to normal pressure of 10N/m$^2$ acting all over the surface. Determine the change in its volume. Given Bulk modulus of lead is $4.58 \times 10^{10}$ N/m$^2$. **(06 Marks)**

5 a. State and prove Gauss Divergence theorem. **(06 Marks)**

b. Describe three types of optical fibres with one application for each type. **(09 Marks)**

c. Calculate the curl of $\vec{A}$. Given $\vec{A} = (1 + yz^2)\,\hat{a}_x + xy^2 + x^2y\,\hat{a}_z$. **(05 Marks)**

6 a. Discuss Continuity equation and list the four Maxwell's equations. **(10 Marks)**

b. What is Numerical Aperture? Derive and expression for numerical aperture interms of refractive indices of core and cladding. **(06 Marks)**

c. Find the attenuation in an optical fiber of length 500m. When a light signal of power 100mw. Emerges out of the fiber with a power 90mw. **(04 Marks)**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

7 a. State Heisenberg's uncertainity principle. Show that electron does not exist inside the nucleus by this principle. **(06 Marks)**

b. Explain the terms Spontaneous emission and stimulated emission. Derive the expression for energy density of radiation under equilibrium condition interms of Einstein's coefficients. **(10 Marks)**

c. An electron is bound in an one dimensional potential well of width 1A°, but infinite height. Find its energy values in ground state and in the first two excited states. **(04 Marks)**

8 a. Using time independent wave equation, find Energy Eigen values and Eigen functions for a particle in one dimensional potential well of infinite height. **(09 Marks)**

b. Describe the Construction and working of $CO_2$ Laser with energy level diagram. **(07 Marks)**

c. The average output Power of Laser source emitting a laser beam of wavelength 6328A° is 5mw. Find the number of Photons emitted per second by the laser source. **(04 Marks)**

9 a. Define Fermi energy and Fermi factor. Derive an expression for Fermi energy at Zero Kelvin. **(09 Marks)**

b. Obtain the expression for electrical conductivity of Semi Conductor. **(07 Marks)**

c. If a NaCℓ crystal is subjected to an electric field of 1000V/m and the resulting Polarization is $4.3 \times 10^{-8}$ C/m$^2$. Calculate the dielectric constant of NaCℓ. **(04 Marks)**

10 a. Discuss any two success of Quantum Free Electron theory. **(06 Marks)**

b. State Hall effect. Obtain an expression for Hall Coefficient. **(08 Marks)**

c. Derive Calusius – Mossotti equation. **(06 Marks)**

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CBCS SCHEME

USN | | | | | | | | | | |

17PHY12/22

# First/Second Semester B.E. Degree Examination, July/August 2021
## Engineering Physics

Time: 3 hrs. Max. Marks: 100

**Note:** *1. Answer any FIVE full questions.*

*2. Physical constants : Plank's constant, $h = 6.63 \times 10^{-34}$ JS, Electron charge, $e = 1.602 \times 10^{-19}$C velocity of light, $C = 3 \times 10^{8}$m/s, Mass of electron $m_e = 9.11 \times 10^{-31}$ kg, Boltzmann's constant, $K = 1.38 \times 10^{-23}$J/K, Avogadro's number, $N_A = 6.23 \times 10^{23}$ molecule/mole.*

1 a. State assumptions of quantum theory of radiation. Explain how Plank's radiation law reduces to Wein's law and Rayleigh – Jean's law under certain conditions. **(08 Marks)**

b. Define the group velocity and phase velocity. Obtain relation between them. **(08 Marks)**

c. The inherent uncertainty in the measurement of time spent by Iridium – 191 nuclei in the excited state is found to be $1.4 \times 10^{-10}$S. Estimate the uncertainty that results in its energy in ev in the excited state. **(04 Marks)**

2 a. State and explain Heisenberg uncertainty principle. Discuss its significance and show that a free electron cannot exist within the nucleus of an atom. **(08 Marks)**

b. Setup time-independent Schrodinger wave equation and explain eigen function and eigen values. **(08 Marks)**

c. Calculate the de-Broglie wavelength associated with an electron with a kinetic energy of 2000ev. **(04 Marks)**

3 a. Discuss the various drawbacks of classical free electron theory. What are the assumptions made in quantum free electron theory to overcome the same? **(08 Marks)**

b. Define Fermi energy and Fermi factor. And discuss the Fermi factor f(E), for cases $E < E_F$, $E > E_F$ at $T = 0$ and $E = E_F$ at $T \neq 0$. **(08 Marks)**

c. The resistivity of intrinsic germanium at 27°C is equal to 0.47 ohm-metre. Assuming electron and hole motilities as 0.38 and $0.18 m^2V^{-1}S^{-1}$ respectively. Calculate the intrinsic carrier density. **(04 Marks)**

4 a. Explain types of superconductors. And write a short note on Maglev vehicle. **(08 Marks)**

b. Give the expressions of concentration of electrons and holes in an intrinsic semiconductor. Obtain the expression for electrical conductivity of intrinsic semiconductor. **(08 Marks)**

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 $20 \times 10^{-3}$ ohm carries a current of 15A. Given the mobility of free electrons in copper is $4.3 \times 10^{-3}$ $m^2$/VS. **(04 Marks)**

5 a. Explain construction and working of $CO_2$ laser with energy level diagram. **(08 Marks)**

b. Discuss types of optical fibers with neat diagrams. **(06 Marks)**

c. Define the terms :
   i) Population inversion
   ii) Stimulated emission
   iii) Optical pumping. **(03 Marks)**

d. A medium in thermal equilibrium at temperature 300k has two energy levels with a wavelength separation of 1μm. Find the ratio of population densities of upper and lower levels. **(03 Marks)**

6 a. Derive an expression for energy density of radiation interms of Einstein's coefficients. **(06 Marks)**

b. Describe the recording and reconstruction processes in Holography with the help of suitable diagrams. **(06 Marks)**

c. Discuss the point to point optical fiber communication system. **(04 Marks)**

d. Calculate the numerical aperture and angle of acceptance of a given optical fiber. If the refractive indices of the core and cladding are 1.563 and 1.498 respectively. **(04 Marks)**

7 a. Derive the expression for interplanar spacing interms of Miller indices for cubic structure. **(05 Marks)**

b. Describe briefly the seven crystal systems. **(07 Marks)**

c. Define allotropy and polymorphism with examples. **(04 Marks)**

d. Draw the following planes in a cubic unit cell :
   i) (100) ii) $(1\bar{2}1)$ iii) (132) iv) (101). **(04 Marks)**

8 a. Describe crystal structure of diamond. **(06 Marks)**

b. What are Miller indices? Explain the procedure to find the Miller indices with an example. **(05 Marks)**

c. Define packing factor and calculate the packing factor for BCC and FCC crystal structures. **(05 Marks)**

d. Calculate the glancing angle for incidence of X-rays for wavelength 0.58°A on the plane (132) of NaCℓ, which results in second order diffraction maxima taking the lattice spacing as 3.81°A. **(04 Marks)**

9 a. With the neat diagram, explain construction and working of Reddy shock tube. **(06 Marks)**

b. Describe arc discharge method of obtaining carbon nanotubes with the help of a diagram. **(05 Marks)**

c. Define Mach number. Distinguish between subsonic and supersonic waves with example. **(05 Marks)**

d. Describe sol-gel method of producing nano-materials. **(04 Marks)**

10 a. Describe the principle, construction and working of a Scanning Electron Microscope (SEM). Give two applications. **(08 Marks)**

b. What is shock wave? State laws of conservation of mass, momentum and energy of a closed system. **(04 Marks)**

c. Describe the density of states for various quantum structures. **(08 Marks)**

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CBCS SCHEME

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21PHY12

# First Semester B.E./B.Tech. Degree Examination, Feb./Mar. 2022
## Engineering Physics

Time: 3 hrs. Max. Marks: 100

**Note: 1.** ***Answer any FIVE full questions, choosing ONE full question from each module.***
**2.** ***Draw neat sketches wherever necessary.***
**3.** ***Physical constants : Speed of light "C" = $3 \times 10^8$ m/s$^{-1}$ ;***
***Planck's constant "h" = $6.625 \times 10^{-34}$ JS ; Boltzmann constant "K" = $1.38 \times 10^{-23}$ J/K$^{-1}$***
***Acceleration due to gravity "g" = 9.8 m/s$^{-2}$ ;***
***Permittivity of Free space "$\epsilon_0$" = $8.854 \times 10^{-12}$ F/m$^{-1}$.***



### Module-1

1 a. What is Free and Forced Oscillation? Obtain expression for Amplitude and phase of vibration in case of forced vibration. **(09 Marks)**

b. Describe the construction and working of the Reddy shock tube. **(06 Marks)**

c. Calculate the peak amplitude of vibration of a system whose natural frequency is 1000 Hz when it oscillates in a resistive medium of damping / unit mass of 0.008 rad/s under the action of an external periodic force / unit mass of 5N/m with tunable frequency. **(05 Marks)**

**OR**

2 a. What is Force Constant? Obtain expression for effective Spring constant and Time period for two springs connected in series. **(08 Marks)**

b. Define Simple Harmonic Motion and give two examples. Obtain the differential equation for Simple Harmonic Motion using Hooke's Law. **(08 Marks)**

c. In a Reddy shock tube experiment, the time taken to travel between the two sensors is 195 μs. If the distance between the two sensors is 100mm. Calculate the mach number. Assume speed of sound as 340 m/s. **(04 Marks)**

### Module-2

3 a. Discuss the spectral distribution of energy in the black body radiation spectrum and hence explain Wein's Displacement Law. **(06 Marks)**

b. Using the Schrodinger Time Independent wave equation , obtain expression for Energy Eigen values and the Normalized wave function. **(09 Marks)**

c. The position and momentum of an electron with energy 0.5 Ke V is found with a minimum percentage uncertainty in momentum. Find its uncertainty if the measurement of position has a uncertainty of 0.5A°. **(05 Marks)**

**OR**

4 a. What is Wave function? Arrive at the Time Independent Schrodinger Wave equation. **(08 Marks)**

b. State and explain Heisenberg's Uncertainty principle and hence use it to show that electrons do not exist inside the nucleus. **(08 Marks)**

c. Evaluate the De – Broglie wavelength of Helium Nucleus accelerated through a potential difference of 500V. **(04 Marks)**

## Module-3

5 a. Distinguish between the types of optical fibres based on Refractive Index profile and number of modes of propagation. **(06 Marks)**

b. Obtain the expression for Energy density using Einstein's A and B coefficients. Draw inference on the condition $B_{12} = B_{21}$. **(10 Marks)**

c. A pulse from laser with power 1mW lasts for 10nS, if the number of photons emitted per pulse is $3.491 \times 10^7$. Calculate the wavelength of laser. **(04 Marks)**

**OR**

6 a. Discuss the construction and working of the $CO_2$ laser. Explain the significance of Helium gas in the $CO_2$ laser system. **(09 Marks)**

b. Give the basics of point to point communication using optical fibres. **(06 Marks)**

c. Calculate the NA , Relative RI , V number and the number of modes in an optical fiber of core diameter 50 μm and the core and cladding R.I are 1.41 and 1.40 respectively. Given Wavelength of source 820nm. **(05 Marks)**

## Module-4

7 a. What is Fermi Factor? Discuss the dependence of Fermi factor on temperature and energy. **(08 Marks)**

b. Mention the four assumptions of Quantum free Electron theory and hence discuss any two success of Quantum free Electron theory. **(08 Marks)**

c. The resistivity of intrinsic germanium at 27°C is equal to 0.47 ohm meter. Assuming electron and hole concentration to be 0.38 $m^2 V^{-1} S^{-1}$ and 0.18$m^2 V^{-1} S^{-1}$. Calculate the Intrinsic carrier density. **(04 Marks)**

**OR**

8 a. What is Hall effect? Obtain expression for the Hall voltage in terms of charge density also state importance of Hall effect. **(08 Marks)**

b. Define Internal Field. Derive the Clausius – Mossotti equation. **(07 Marks)**

c. Find the temperature of which there is 1% probability that a state with an energy 0.2eV above Fermi level is occupied. **(05 Marks)**

## Module-5

9 a. Explain the construction and working of X – Ray diffractometer. **(07 Marks)**

b. Describe in brief the construction and working, with Principle the Transmission Electron Microscope. **(08 Marks)**

c. Determine the crystal size when the peak width is 0.5° and peak position 30° for a cubic crystal. The wavelength of X rays used is 100A° and the Scherer's constant K = 0.92. **(05 Marks)**

**OR**

10 a. With a neat sketch, explain the principle , construction and working of Scanning Electron Microscope. **(09 Marks)**

b. Describe the construction, principle and working of X – ray Photoelectron Spectroscope. **(08 Marks)**

c. Mention applications of Atomic Force Microscope. **(03 Marks)**

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