ARYA COLLEGE OF ENGINEERING (ACE) , Jaipur

GUESS PAPER

(B.Tech. I Sem/II Sem)

1FY2-02/2FY2-02 ENGINEERING PHYSICS

Unit-1: (Wave Optics)

Short answer (2 Marks Each)

Q.1. Explain why central fringe is dark in reflected light in Newton's ring?
Q.2. What will be effect on Newton's ring if a plano convex lens of small radius of curvature is used? **{RTU JULY 22}**
Q.3. What will be the effect on Newton's rings if a plane mirror is placed instead of the glass plate below the plano-convex lens? **{RTU APRIL 22}**
Q.4. How does Michelson's ring differ from Newton's ring? **{RTU MAR 21}**
Q.5. What is the role of compensatory plate in Michelson interferometer? **{RTU APRIL 22},{RTU May 19}**
Q.6. Show the difference between Fraunhofer and Fresnel diffraction? **{RTU May 19}**
Q.7. Explain what is X-ray and XRD? **{RTU MAR 21}**
Q.8. What is mean by zero order spectrum in plane transmission grating?

Descriptive answers: (5 to 20 Marks)

Q.1. Explain the formation of Newton's ring in reflected light and prove that the diameters of dark rings are proportional to the square root of natural numbers? **{RTU MAR 21}**
Q.2. Explain the working of Michelson Interferometer? How circular fringes be produced with it? Show with necessary theory how it use to measure the difference in wavelength between the lines of sodium light? **{RTU MAR 21}, {RTU May 18}**
Q.3. Light containing two wavelengths λ_1 and λ_2 falls normally on a plano-convex lens of radius of curvature R resting on a glass plate. If the n^{th} dark ring due to λ_1 coincide with the $(n+1)^{th}$ dark ring due to λ_2 prove that the radius of the n^{th} dark ring of λ_1 is $\sqrt{\frac{\lambda_1\lambda_2 R}{\lambda_1-\lambda_2}}$ **{RTU APRIL 22},{RTU May 19}**
Q.4. Discuss the phenomenon of Fraunhofer diffraction at single slit and show that the relative intensities of successive maxima are nearly: **{RTU APRIL 22}**

$$1 : 4/9\pi^2 : 4/25\pi^2 : 4/49\pi^2 \ldots\ldots\ldots\ldots$$

Q.5. Prove the intensity of light diffracted from a plane transmission grating is given by

$$I = I_0 \left(\frac{\sin\alpha}{\alpha}\right)^2 \left(\frac{\sin N\beta}{\sin\beta}\right)^2$$

Find the positions of maxima and minima and calculate the width of n^{th} principal maxima. **{RTU Dec 19}**

Q.6. Explain Rayleigh criterion of resolution. What is meant by resolving power of a grating? **{RTU APRIL 22},{RTU JULY 22},{RTU MAR 21}, {RTU May 19},{RTU May 18}**

Q.7. What is Bragg's law? Using Bragg's law determine how the wavelength of X-ray beam is determined. **{RTU MAR 21},{RTU May 18}**

Unit-2:(Quantum Physics)

Short answer (2 Marks Each)

Q.1. Write short note on physical interpretation of wave function. **{RTU APRIL 22},{RTU JULY 22},{RTU Dec 19}**

Q.2. What is meant by normalization and orthogonal of a wave function? **{RTU MAR 21}**

Q.3. Explain why wave function must be single valued and continuous function of position? **{RTU MAR 21}**

Q.4. What is zero point energy for a particle trapped in one dimensional box? **{RTU APRIL 22},{RTU May 19}**

Q.5. Explain the degeneracy, order of degeneracy and non degenerate state. **{RTU APRIL 22}**

Descriptive answers: (5 to 20 Marks)

Q.1. Derive Schrodinger's time dependent wave equation. **{RTU Dec 19}**

Q.2. Derive the Schrodinger's time independent wave equation. **{RTU Dec 19}**

Q.3. Explain the wave particle duality and show that group velocity is equal to the velocity of particle.

Q.4. Write down the Schrodinger's time independent wave equation for a free particle confined in one dimensional box of size a. Obtain Eigen values and normalized wave equation for this particle. **{RTU MAR 21}**

Q.5. Write down Schrodinger's equation for a particle in a 3-D box. Obtain the wave function for a particle confined in this box. **{RTU APRIL 22}**

Unit-3:(Coherence and Optical Fiber)

Short answer (2 Marks Each)

Q.1. Distinguish between coherent and non-coherent light? **{RTU May 18}**

Q.2. What is temporal and spatial coherence? **{RTU JULY 22},{RTU MAR 21}, {RTU Dec 19},{RTU May 18}**

Q.3. Explain the term coherence length and coherence time. **{RTU APRIL 22}**

Q.4. What do you mean by "Q" factor for light? What is visibility? **{RTU JULY 22},{RTU Dec 19}**

Q.5. Define optical fiber. What is the working principle of optical fiber? **{RTU APRIL 22}**

Q.6. Write down the applications of optical fibre? **{RTU Dec 19},{RTU May 19}**

Descriptive answers: (5 to 20 Marks)

Q.1. What is spectral purity? Derive an expression for coherence length and coherence time in terms of wavelength and frequency.

Q.2. How does monochromaticity relative to temporal coherence? Define Q factor for a spectral line.

Q.3. Show that visibility is a measure of coherence. **{RTU Dec 19},{RTU May 19}**

Q.4. What is optical fibre? Describe construction and working of the optical fibre. **{RTU MAR 21}**

Q.5. Derive an expression for the maximum acceptance angle and numerical aperture of an optical fibre. **{RTU JULY 22},{RTU MAR 21}**

Q.6. What is fractional refractive index change (Δ)? How is it related to numerical aperture? **{RTU APRIL 22},{RTU May 18}**

Unit-4:(Laser)

Short answer (2 Marks Each)

Q.1. Give the basic properties of a laser. **{RTU MAR 21}**

Q.2. Distinguish between Spontaneous emission and Stimulated emission. **{RTU JULY 22},{RTU MAR 21},{RTU May 19}**

Q.3. Explain, what is role of metastable state in laser media?

Q.4. What is mean by population inversion? Write threshold conditions for laser action. **{RTU JULY 22},{RTU Dec 19}**

Q.5. Mention any three engineering applications of laser?

Q.6. What are the essential requirements for producing laser action? **{RTU APRIL 22}**

Descriptive answers: (5 to 20 Marks)

Q.1. Explain the term absorption, spontaneous emission and stimulated emission and derive relation between Einstein's coefficients. **{RTU Dec 19}**

Q.2. What are an active medium, population inversion and optical pumping in reference to laser action? **{RTU May 19}**

Q.3. Explain the theory of laser action?

Q.4. Explain the construction and working of a He-Ne laser. Draw necessary diagram. What is the role of He in this laser. **{RTU APRIL 22},{RTU May 18}**

Q.5. What is basic requirement of semiconductor laser? Draw its label diagram and explain it's working with necessary theory, write down the application of semiconductor laser. **{RTU JULY 22},{RTU MAR 21}**

Unit-5:(Material Science and Semiconductor)

Short answer (2 Marks Each)

Q.1. What do you mean by the term 'Bonding in solids'. **{RTU May 19}**
Q.2. Draw a band diagram for a semiconductor.
Q.3. Define n-type and p-type semiconductors.
Q.4. Define Fermi energy. **{RTU Dec 19}**
Q.5. Write a short note on the applications of Hall Effect.

Descriptive answers: (5 to 20 Marks)

Q.1. Explain the covalent and metallic bonding. **{RTU JULY 22},{RTU MAR 21}, {RTU May 19}**
Q.2. Classify the elements as conductors, insulators and semiconductors on the basis of band theory of solids with suitable diagram. **{RTU APRIL 22}, {RTU Dec 19}**
Q.3. Write a short note on intrinsic and extrinsic semiconductors. **{RTU APRIL 22},{RTU Dec 19}**
Q.4. Explain the Fermi-Dirac distribution function. **{RTU JULY 22}, {RTU May 19}**
Q.5. Derive the expression for conductivity in an intrinsic and extrinsic semiconductor.
Q.6. Explain Hall Effect. Obtain the expression for Hall coefficient, Hall voltage and Hall mobility. **{RTU APRIL 22},{RTU JULY 22},{RTU Dec 19}**

Unit-6:(Introduction to Electromagnetism)

Short answer (2 Marks Each)

Q.1. What is physical interpretation of Gradient?
Q.2. What is physical interpretation of Divergence and curl? **{RTU APRIL 22}, {RTU MAR 21},{RTU May 19}**
Q.3. What is mean by $\vec{\nabla}.\vec{B} = 0$
Q.4. What do you mean by the flux of an electric field?
Q.5. What is physical interpretation of pointing vector?
Q.6. Prove the divergence of a field is a scalar.
Q.7. What do you mean by Maxwell's equations? **{RTU JULY 22}**

Descriptive answers: (5 to 20 Marks)

Q.1. Show that curl of a vector field is a vector quantity and also gives its physical interpretation.
Q.2. Deduce the Maxwell's equations for free space and prove that electromagnetic waves are transverse. **{RTU MAR 21}**
Q.3. Explain the concept of Maxwell's displacement current and show it led to the modification of Ampere's law? **{RTU APRIL 22},{RTU May 19}**
Q.4. Explain the Poission's and Laplace's equation for electromagnetic

potential. **{RTU Dec 19}**

Q.5. Explain the Biot-Savart law and Faraday's law of electromagnetic induction? **{RTU JULY 22},{RTU MAR 21},{RTU Dec 19}**

Q.6. Deduce the Poynting vector and explain the physical significance for various terms involved in the expression. **{RTU APRIL 22},{RTU JULY 22},{RTU MAR 21},{RTU May 19}**

Unit-1: (Wave Optics)

PART – A

Q.1. What is Diffraction?
Q.2. Draw labeled diagram of Michelson's Interferometer.
Q.3. Write two differences between Haidinger fringes and Fizeau fringes.
Q.4. Explain the role of compensating glass plate in Michelson's Interferometer.
Q.5. Enumerate the difference between Fresnel and Fraunhofer class of diffraction.
Q.6. What is interference of light?
Q.7. Explain Bragg's law.
Q.8. Explain the meaning of resolving power.
Q.9. What is X-ray diffraction?
Q.10. Why are Newton's rings circular in shape?
Q.11. What will be the effect on Newton's rings if a plane mirror is placed instead of the glass plate below the plano-convex lens?
Q.12. What is the role of compensatory plate in Michelson interferometer?
Q.13. Why visible light cannot be used in diffraction by a crystal?
Q.14. What will happen if we use a lens (Newton's Ring) of small radius of curvature?
Q.15. State Rayleigh's criterion of resolution.
Q.16. Excessively thin film appears dark why?
Q.17. What do you mean by resolving power of an optical instrument?
Q.18. What will be the effect on diameters in Newton's ring experiment if film is of μ refractive index?
Q.19. How do circular fringes originate in Michelson's Interferometer?
Q.20. Calculate the longest wavelength that can be analyzed by a crystal of spacing d = 3.64 A^0 in the second order?
Q.21. When the movable mirror of Michelson's interferometer is shifted by 0.030 mm, the shift of 100 fringes are observed. Calculate the wavelength of light in A^0 and state its colour.
Q.22. State Rayleigh's criterion of resolution.

PART – B

Q.1. In Newton's ring experiment, the diameters of the 4^{th} and 12^{th} dark rings are 0.400 cm and 0.700 cm respectively. Find the diameter of the 20^{th} dark ring.
Q.2. A diffraction grating is just able to resolve two lines of λ = 5140.34 A^0 and 5140.85 A^0 in the first order. Will it resolve the lines 8037.20 A^0 and 8037.50 A^0 in the second

order?

Q.3. Light containing two wavelength λ_1 and λ_2 falls normally on a Planoconvex lens of radius of curvature R resting on a glass plate. If the n^{th} dark ring due to λ_1 coincides with $(n+1)^{th}$ dark ring due to λ_2, then prove that the radius of n^{th} dark ring of λ_1 is given by,

$$r_n = \left(\frac{\lambda_1 \lambda_2 R}{\lambda_1 - \lambda_2}\right)^{1/2}$$

Q.4. A diffraction grating has 5000 lines per cm and the total ruled width is 5 cm. Calculate dispersion for a wavelength of 5000 A^0 in the second order.

Q.5. A diffraction grating has total ruled width 5 cm for normal incidence. It is found that a line of wavelength 6000 A^0 in a certain order superimposed on another line of wavelength 4500 A^0 of the next highest order. If the angle of diffraction is 30^0, how many lines are there in the grating?

Q.6. A diffraction grating just resolves lines 4547.27 A^0 and 4547.98 A^0 in the third order. Will it resolve lines 6437.48 A^0 and 6437.95 A^0 in the first order?

Q.7. A single slit is illuminated by light composed of two wavelength λ_1 and λ_2. One observes that due to diffraction, the first minima obtained for λ_1 coincides with the second diffraction minima of λ_2. What will be the relation between λ_1 and λ_2?

Q.8. A laser beam has a power of 50 mW. It was an aperture of 5×10^{-3} m and wavelength 7000 A^0. A beam is focused with a lens of focal length 0.2 m. Calculate the area spread and intensity of the image.

Q.9. A plane transmission grating of length 6 cm has 5000 lines/cm. Find the resolving power of grating and the smallest wavelength difference that can be resolved for the light of wavelength 5000 A^0.

Q.10. Calculate the angles at which the first dark band and the next bright band are formed in the Fraunhofer diffraction pattern of a slit 0.3 mm wide (λ = 5890 A^0).

Q.11. In Newton's ring arrangment with air film observed with light of wavelength 6×10^{-5} cm, the difference of squares of diameters of successive ringes is 0.125 cm^2. What will happen to this quantity if:

(i). Wavelength of light is changed to 4.5×10^{-5} cm.

(ii). A liquid of refractive index 1.33 is introduced between the lens and the plate.

(iii). The radius of curvature of the convex surface of the Plano-convex lens is doubled?

Q.12. Write a short note on resolving power. What do you understand by geometrical & spectral resolving power?

Q.13. What are Newton's rings? Explain the formation of Newton's ring in reflected light. Prove that in reflected light the diameters of dark rings are proportional to the square root of natural numbers.

Q.14. Derive an expression for resolving power of a grating.

Q.15. Give the construction and theory of plane transmission grating and explain the formation of spectra by it.

PART – C

Q.1. Prove the intensity of light diffracted from a plane transmission grating is given by

$$I = I_0 \left(\frac{\sin \alpha}{\alpha}\right)^2 \left(\frac{\sin N\beta}{\sin \beta}\right)^2$$

Where symbols have their usual meanings. Find the positions of maxima and minima.

Q.2. Derive the following the expression for plane transmission grating

(i). $I = I_0 \left(\frac{\sin \alpha}{\alpha}\right)^2 \left(\frac{\sin N\beta}{\sin \beta}\right)^2$

(ii). Angular width of n^{th} principal maxima, $2d\theta_n = 2\tan\theta/nN$

Q.3. (a). Describe the construction and working of Michelson Interferometer.

(b). Find the difference between Newton's ring and Michelson Interferometer.

Q.4. Derive an expression for the intensity of diffracted light in the Fraunhofer diffraction due to single slit and show that the relative intensities of successive maxima are in the ratio:

$$1 : 4/9\pi^2 : 4/25\pi^2 : 4/49\pi^2 \ \ldots\ldots\ldots\ldots$$

Q.5. Describe and explain the formation of Newton's ring in reflected monochromatic light. How can these be used to determine the wavelength of light? Derive the formula used.

Q.6. Derive an expression for the intensity of diffracted light in the Fraunhofer diffraction due to single slit and deduce the position of maxima, minima and secondary maxima.

Unit-2:(Quantum Physics)

PART – A

Q.1. Define Matter waves.

Q.2. Define basic postulates of wave function.

Q.3. Explain the meaning of zero point energy.

Q.4. Explain normalized and orthogonal wave functions.

Q.5. Write the basic postulates of wave function.

Q.6. What is zero point energy for a particle trapped in one dimensional box?

Q.7.What are the necessary conditions of physically acceptable wave function?

Q.8.What is the physical interpretation of wave-function?

Q.9.What are the normalized and orthogonal wave function?

Q.10.What is wave function and write basic postulates of wave function?

Q.11.Define the term matter wave and wave – particle duality?

Q.12.What do you mean by eigenfunction and eigenvalues?

Q.13.Find the lowest energy of an electron confirmed to move in one dimensional potential box of length 1 A^0.

PART – B

Q.1. An electron is trapped in infinitely deep cubical potential well of width 1 A^0. What is its first excitation energy? (Give $m_e = 9.1 \times 10^{-31}$ kg, $h = 6.62 \times 10^{-34}$ Js)

Q.2. Calculate first two energy levels of an electron confined in a rigid potential box of width $1A^0$.

Q.3. Find the lowest energy of an electron confined to move in a one dimensional potential box of width 1 A^0.

Q.4. A particle is in cubical box of length 'a' in its ground state. Find the probability that a particle will be found in a volume defined by –

$$0 \le x \le \frac{a}{2}, 0 \le y \le \frac{a}{2}, 0 \le z \le \frac{a}{2}$$

Q.5. Find the probability that a particle in a box of width a can be found between x = 0 and x = a/n when it is in the n^{th} state.

Q.6. An electron is confined to a one dimensional box of side 1 A^0. Obtain the first four Eigen value of the electron in eV.

Q.7. Find the probability that a particle is in one dimensional box of length L can be found between 0.45 L and 0.55 L for the ground and first excited states.

Q.8. Consider a particle moving in a one dimensional potential box of infinite height of 25×10^{-10} m width. Estimate the probability of finding the particle within an interval of 5×10^{-10} m at the center of the box when it is in its state of least energy.

PART – C

Q.1. Derive Schrodinger's time dependent wave equation and time independent wave equation. Give physical significance of wave function.

Q.2. Derive Schrodinger's time dependent wave equation and time independent wave equation. Write down the equation for a free particle confined in one dimensional box of size 'ɑ'. Obtain Eigen values and normalized wave function for this particle.

Q.3. Write Schrodinger's equation for a particle of mass 'm' trapped in one dimensional box of size 'ɑ'. Write an expression for its energy Eigen values. How would solutions get modified if the particle were in a three dimensional cubical box of side 'a'?

Q.4. Solve the Schrodinger's equation for a free electron in a 3-Dimensional box and find the energy eigen value and eigen function of free electron. Find the lowest energy of the following states:

i). Non-degenerate.

ii). Triply degenerate for the 3-dimensional cubical box.

Q.5. (a). Derive Schrodinger's time dependent wave equation and explain physical meaning of wave function ψ.

(b). What do you mean by degeneracy?

Q.6. Derive time dependent and time independent Schrodinger wave equation.

Q.7. Give physical significance of wave function. Derive time dependent and time independent Schrodinger wave equation.

Unit-3:(Coherence and Optical Fiber)

PART – A

Q.1. **Write any two advantages and applications of an optical fibre.**

Q.2. **Explain temporal and spatial coherence.**

Q.3. **What is the meaning of acceptance angle?**

Q.4. **Define optical fiber. What is the working principle of optical fiber?**

Q.5. **Define coherence length and coherence time?**

Q.6. **What do you mean by "Q" factor for light?**

Q.7. **Define spatial and temporal coherence.**

Q.8. **Explain total internal reflection.**

Q.9. **What do you mean by spectral purity?**

Q.10. **Define spatial and temporal coherence?**

Q.11. **Calculate the numerical aperture and acceptance angle of an optical fiber. Given refractive index of fiber core = 1.62 and refractive index of cladding = 1.52.**

Q.12. **Define Spatial and Temporal coherence.**

PART – B

Q.1. Calculate the coherence time and coherence length of white light of wavelength range from 3500 A^0 to 6500 A^0.

Q.2. Two coherent sources of intensity ratio α interfere. Prove that in the interference pattern.

$$\frac{I_{max} - I_{min}}{I_{max} + I_{min}} = \frac{2\sqrt{\alpha}}{1+\alpha}$$

Q.3. An optical fibre has a numerical aperture of 0.2 and cladding refractive index of 1.59. Determine the acceptance angle for the fiber in water which has a refractive index of 1.33.

Q.4. The spectral spread of a red cadium light of wavelength 694.3 nm is 0.001 nm. Calculate spectral purity factor, coherence length or coherence time.

Q.5. A ray of light entres from air into fiber. The refractive index of air is one. The fiber has a core of refractive index 1.5 and cladding of refractive index 1.48. Find the critical angle, the fractional refractive index, acceptance angle and numerical aperture.

Q.6. How optical fibers can be used in Medical, Science and Communication field?

Q.7. Write the expression for visibility and show that visibility is a measure of coherence.

Q.8. Define numerical aperture of an optical fibre. Prove that numerical aperture of step index optical fibre is given by

$NA = \mu_{Core}\sqrt{2\Delta}$, where symbols have their usual meanings.

Q.9. What is Numerical Aperature (NA) of an optical fiber? What does the numerical aperature signify?

PART – C

Q.1. Define spatial and temporal coherence with their examples. Show that visibility is a measure of degree of coherence.

Q.2. What is an optical fibre? Describe construction and working of the optical fibre. Find an expression for numerical aperture of a step index optical fibre.

Q.3. (a). What is an optical fibre? Obtain an expression for numerical aperture of step index optical fibre.

(b). Explain visibility of fringes as a measure of coherence.

Unit-4:(Laser)

PART – A

Q.1. What is 'Q' factor in Laser?

Q.2. What is Population Inversion?

Q.3. What do you understand by term pumping in LASER system?

Q.4. What are the essential requirements for producing laser action.

Q.5. Write threshold conditions for laser action.

Q.6. What is the difference between spontaneous and stimulated emission.

Q.7. What are the relation between Einstein's Coefficients? Explain them.

Q.8. Define the difference between the absorption, spontaneous and stimulated emission?

Q.9. **Write the threshold conditions for the laser action?**
Q.10. **What do you mean by stimulated emission and spontaneous emission?**

PART – B

Q.1. LASER action occurs by stimulated emission from an excited state to a state of energy 30.5eV. If the wavelength of LASER light emitted is 690 nm, what is the energy of the excited one?
Q.2. In a He-Ne laser system, the two energy levels of Ne involved in lasing action have energy value of 20.66eV and 18.76eV. Population inversion occurs between these two levels. What will be the wave length of a laser beam produced?
Q.3. A gaseous medium give a laser at an infrared wavelength of 3.4 μm. What is the difference of energy between the upper and lower levels?
Q.4. In an He-Ne laser system, the two energy levels of Ne involved in lasing action have energy values of 20.66 eV and 18.76 eV. Population inversion occurs between these two levels. What will be the wavelength of a laser beam produced?
Q.5. Derive the relation between the Einstein coefficients and discuss the result.
Q.6. What is the difference between Spontaneous and Stimulated emission. Why is Spontaneous radiation incoherent?
Q.7. Distinguish between Spontaneous and induced emissions. How does induced emission dominate in He-Ne laser?
Q.8. Give the construction and working of semiconductor laser. Draw the necessary energy level diagrams.
Q.9. Prove that in high frequency region Laser action is not possible.

PART – C

Q.1. Describe the construction and working of a He-Ne laser. How is population inversion acheived in such a laser.
Q.2. Explain the term absorption, spontaneous emission and stimulated emission. Also derive the relation between Einstein's coefficients for laser action and discuss the result. Describe the construction and working of a He-Ne laser with neat labelled diagram.
Q.3. (a). Draw a neat labelled diagram of semiconductor laser and explain it's working.
(b). Explain the reasons for the following properties of laser –
(i). High directionality
(ii). High intensity
Q.4. With the help of suitable diagram, explain the principle, construction and working of He-Ne laser.
Q.5. Prove that in high frequency region Laser action is not possible.
Q.6. Explain the construction and working of a He-Ne laser. Draw necessary diagrams. What is the role of He in this laser.
Q.7. Explain the terms: Population inversion and optical pumping. Discuss with suitable diagrams the principle, construction and working of Helium-Neon laser.

Unit-5:(Material Science and Semiconductor)

PART – A

Q.1. Define Fermi energy.
Q.2. Define Intrinsic and Extrinsic semiconductors.
Q.3. Why a semiconductor behaves like an insulator at 0K temperature?
Q.4. What is Hall Effect? Write expression for Hall coefficient.
Q.5. Define Fermi distribution function & show the dependence of it on temperature.
Q.6. What are intrinsic and extrinsic semiconductors?
Q.7. What do mean by covalent and metallic bonding.
Q.8. What is Hall Effect?
Q.9. Write a difference between the intrinsic and extrinsic semiconductors?
Q.10. Define Fermi Dirac function and Fermi energy?
Q.11. The carrier concentration in n-type semiconductor 10^{19} per m^3. What is the value of Hall coefficient?

PART – B

Q.1. For intrinsic silicon, at room temperature the electrical conductivity is $4 X 10^{-4}\ \Omega^{-1}m^{-1}$. The electron and hole mobilities are $0.14\ m^2V^{-1}s^{-1}$ and $0.040\ m^2V^{-1}s^{-1}$ respectively. Compute the intrinsic charge carrier density at room temperature.

Q.2. Calculate the conductivity of the intrinsic germanium at 300 K. Given $n_i = 2.4 \times 10^{19}/m^3$, $\mu_e = 0.39\ m^2V^{-1}s^{-1}$ and $\mu_p = 0.19\ m^2V^{-1}s^{-1}$.
Q.3. An electric field of 100 V/m is applied to a sample of n-type semiconductor whose Hall coefficient is -0.0125 m^3/Coulomb. Determine the current density in the sample assuming mobility of electrons is 0.36 m^2/V/S.
Q.4. Calculate the conductivity of the intrinsic germanium at 300 K. Given $n_i = 2.4 \times 10^{19}\ per\ m^3, \mu_e = 0.39\ m^2V^{-1}s^{-1}\ and\ \mu_p = 0.19\ m^2V^{-1}s^{-1}$
Q.5. For intrinsic semiconductor with a band gap E_g = 0.7 eV, calculate the density of electrons and holes at 300 K.
Q.6. The Hall voltage for the sodium metal is 0.001 mV, measured at I = 100 mA, B = 2 Tesla, the width of the specimen = 0.05 mm and $\sigma = 2.09 \times 10^7\ \Omega^{-1}m^{-1}$,
(a). Calculate the number of carriers per cubic meter in sodium.
(b). Calculate the mobility of electrons in sodium.
Q.7. Classify the elements as conductors, insulators and semiconductors on the basis of band theory of solids with suitable diagram.
Q.8. Explain the term "Bonding in solids". What do you mean by metallic bonding.
Q.9. Write short notes on the following –
(b). Covalent and Metallic bonding.
Q.10. Explain the Fermi-Dirac distribution function and Fermi energy.

PART – C

Q.1. What is Hall Effect? Give an elementry theory of Hall Effect. Obtain the expression for all Hall coefficients in terms of Hall voltage.
Q.2. Classify the solids as conductors, semiconductors and insulator according to band structure. Derive an expression for electrical conductivity in intrinsic semiconductors. How is the electrical conductivity modified in extrinsic semiconductors.
Q.3. (a). What is Hall Effect. Show that for n-type semiconductor the Hall coefficient is $R_H = -\frac{1}{ne}$
(b). Classify conductor, semiconductor and insulator based on energy band theory.
Q.4. Show that Hall coefficient is independent of the applied magnetic field and is inversly proportional to the current density and electronic charge. Mention the application of Hall effect.
Q.5. (a). Discuss the formation of energy bands in solids.
(b). Classify the solids on the basis of enrgy bands and discuss the conductivity in semiconductors.
Q.6. Show that Hall coefficient is independent of the applied magnetic field and is inversly proportional to the current density and electronic charge.

Unit-6:(Introduction to Electromagnetism)

PART – A

Q.1. State Faraday's law.
Q.2. State Bio-Savart law.
Q.3. Define divergence & its physical significance.
Q.4. Explain Bio-Savart Law.
Q.5. Define divergence of electrostatic field and its physical significance?
Q.6. State Faraday's Law and Bio-Savart Law.
Q.7. What do you mean by Maxwell's equations?
Q.8. **What is scalar and vector field?**
Q.9. **Define Curl and Divergence of a vector.**
Q.10. State Faraday's and Bio – Savart Law?
Q.11. Give the physical significance of divergence and curl of a field?
Q.12. **Write all Maxwell's equations in integral form for free space.**

PART – B

Q.1. If a potential function is given by the expression Φ = xyz, determine the potential gradient and also prove that the vector is ir-rotational.
Q.2. If a potential function is given by the expression, ϕ = xyz, determine the potential gradient and also prove that the vector is irrotational.
Q.3. Write short note on:
(i). Displacement current
(ii). Poynting vector
Q.4. Derive Poission's and Laplace's equation.

Q.5 Write short notes on the following –

(a). Divergence and Curl of static magnetic field.

Q.6. Derive Poission's and Laplace's equation starting from the differential form of Gauss's law.

Q.7. If a potential function is given by the expression, $\phi = xyz$, determine the potential gradient and also prove that the vector is irrotational.

PART – C

Q.1. What are Maxwell's equations? Derive Maxwell's equations in an isotropic medium and in free space.

Q.2. (a). Derive the Maxwell's equations in differential form.

(b). Write a short note on Poynting vector.

Q.3. (a). Define Poynting vector and derive Poynting theorem.

(b). State Amphere's circuital law and using Maxwell's correction, derive fourth Maxwell's equestion.

Q.4. State and prove the Poynting theorem for the rate of flow of energy in electromagnetic field. What is Poynting vector?

Q.5. Derive the formula for Curl and Divergence for electrostatic field nad static magnetic field.

Q.6. State and prove the Poynting theorem for the rate of flow of energy in electromagnetic field. What is Poynting vector?

Q.7. State and prove the Poynting theorem for the rate of flow of energy in electromagnetic field. What is Poynting vector?