FE1903

Total No. of Printed Pages:03

F.E. Semester - I (Revised Course 2019-20)
EXAMINATION FEBRUARY 2022
Physics

[Duration : Three Hours] **[Total Marks :100]**

Instructions:
1. Answer any two questions from Part-A and Part-B each. And any one question from Part -C.
2. Assume additional data if required.
3. Draw diagrams wherever required.

Physical Constants:
Planck's constant $= 6.626 \times 10^{-34}$ J − s
Electron charge $= 1.6 \times 10^{-19}$C -
Boltzmann's constant $= 1.38 \times 10^{-23}$ J/K
Electron mass $= 9.1 \times 10^{-31}$ kg
Rydberg constant $= 1.097 \times 10^{7}$/m
Velocity of Light $= 3 \times 10^{8}$ m/s

PART A

Answer any two questions

Q.1 a) Briefly explain physical origin of Hall effect. Derive an expression for Hall voltage developed. 5

b) Explain 5 properties of Paramagnetic materials. 5

c) In Newton's Rings experiment the diameter of the 5^{th} and 20^{th} dark rings formed due to reflected light were measured as 0.3 cm and 0.6 cm respectively. What was the radius of curvature of the plano-convex lens if wavelength of light used was 6000 Å? What will be diameter of the 5^{th} ring change to if a liquid of a R.I. 1.33 is introduced between the lens and the plate? 5

d) Describe acoustic diffraction method to find velocity of ultrasonic waves in liquid. 5

Q.2 a) What is energy gap? With the help of energy band structure explain three types of solids. Give two examples of each. **5**

b) The Hall coefficient of a doped silicon is found to be 3.66×10^{-4} m^3/c. The resistivity of sample is $8.93 \times 10^{-3} \Omega - m$. Determine the mobility and density of charge carriers, assuming single carrier conduction. **5**

c) Draw block diagram of CRO and explain its application to measure amplitude of DC voltages. **5**

d) Obtain the condition of bright and dark interference due to transmitted light from a parallel **5**

sided thin film.

Q.3 a) Explain the following applications of US waves: 5
i) Detection of flaws in metal casting
ii) SONAR

b) Calculate the velocity of ultrasonic waves in a liquid used in an acoustic diffraction experiment using following data: $\lambda = 5893\ A^0$ 5
Frequency of ultrasonic transducer= 100 MHz
Angle of diffraction for second order Maxima = 4° 30'

c) Show that the diameters of dark circular Newton's rings for reflected light are proportional to the square root of natural numbers. 5

d) Write down features of diamagnetic material. Also give an account of the origin of diamagnetism. 5

PART B

Answer any two Questions

Q.4 a) Describe construction and working of He-Ne laser with necessary diagrams. 5

b) A SI fiber has Core R.I. of 1.44 and cladding R.I. of 1.41. Find i) The Numerical Aperture ii) The relative index difference iii) The acceptance angle 5

c) Describe Davisson-Germer experiment to demonstrate the wave nature of an electron 5

d) What is X-ray diffraction? Derive expression for Bragg's law. 5

Q.5 a) Explain the process of stimulated emission of radiation and how it can be used for light amplification. 5

b) Using De Broglie hypothesis, Calculate the wavelength associated with : 5
i) Ball of mass 10 g moving at a speed of 10 m/s
ii) Electron with K.E. of 100 eV

c) Describe an experiment to verify the Compton effect. Give an account for unmodified peak in the graph.(Intensity Versus scattering angle). 5

d) What is Mosley's law? Give its significance. 5

Q.6 a) Determine the ratio of population of two energy levels out of which one corresponds to metastable state if the wavelength of light emitted at 57 °C is $6328\ A^0$ 5

b) Derive an expression for numerical aperture of optical fiber in terms of fractional refractive index difference. 5

3B659006B25CF197454D0B00D0021F3D

c) Explain the phenomenon of production of Characteristics X-Ray spectrum. 5

d) With neat diagrams explain step-Index and graded -index fibers. 5

PART C

Answer any one Question

Q.7 a) Derive an expression for fringe width in a wedge-shaped film. 5

b) Explain how ultrasonic waves are produced by magnetostriction method. 5

c) Pure Ge at 300K has a density of charge carriers $2.5 \times 10^{19}/m^3$. A specimen of pure Ge is doped with donor impurity atoms at the rate of one impurity atom for every 10^6 atoms of Ge. Assuming that all the impurity atoms are ionized, find the resistivity of the doped Ge if the electron and hole mobilities are $0.36 m^2 v^{-1} s^{-1}$ and $0.18 m^2 v^{-1} s^{-1}$ resp. and the no. of Ge atoms/unit volume is 4.2×10^{28} atoms/m^3. 5

d) What are hard and soft magnetic materials? Give 5 distinguishing points between them. 5

Q.8 a) With the help of a diagram explain four level pumping. What are its advantages? 5

b) With the help of a block diagram, explain the use of optical fibers in communication. Give any two advantages of optical fibers over copper wire communication. 5

c) What is Continuous X ray spectra? Explain their origin. Derive an expression for cutoff wavelength in the spectrum. 5

d) What voltage must be applied to an electron source to produce electron having De Broglie's wavelength of 0.4 A°. What will be K.E. of the electron moving under this potential? 5