B. E. First Semester (ALL) / SoE – 18-19 – Rev – FY-201 Examination

Course Code : GE 2105 **Course Name : Engineering Physics**

Time : 2 Hours] [Max. Marks : 40

Instructions to Candidates :—

(1) Attempt any **Four** questions out of **Six**.
(2) All questions carry **Ten** marks.
(3) Assume suitable data wherever necessary.
(4) Illustrate your answers wherever necessary with the help of neat sketches.
(5) Use of Logarithmic tables, non programmable calculator is permitted.
(6) List of Constants :

Plank's constant $h = 6.625 \times 10^{-34}$ JS
Mass of electron $m_e = 9.1 \times 10^{-31}$ kg
Mass of Proton $m_p = 1.67 \times 10^{-27}$ kg
Charge of electron $e = 1.602 \times 10^{-19}$ C
Boltzmann constant $k = 1.38 \times 10^{-23}$ J/K
Velocity of light $c = 3 \times 10^{8}$ m/s

1. (A) (A1) Draw a well labeled diagram showing the phenomenon of interference due to reflected light in the wedge shaped thin film. State the condition for maxima and minima and explain the terms involved. Obtain an expression of fringe width of interference pattern formed in wedge shaped film. (CO1,PO1)

(A2) A soap film of refractive index **1.333** is illuminated by white light incident at an angle of $\mathbf{45^0}$. The light reflected by it, is examined by spectroscope and two consecutive bright bands are found overlapping corresponding to the wavelengths $\mathbf{6.1 \times 10^{-5}}$ **cm** and $\mathbf{6.0 \times 10^{-5}}$ **cm**. Find the thickness of the film. 6+4(CO1,PO2)

OR

(B) (B1) Give the experimental set up of Newton's rings and explain the formation of Newton's rings in reflected light under normal incidence. Show that the radii of bright rings are proportional to the square root of odd natural numbers. (CO1,PO1)

(B2) For a plane diffraction grating with **5000 lines / cm** used at normal incidence, what is the longest wavelength of light for which a spectrum can be observed ? 7+3(CO1,PO2)

2. (A) (A1) Write Schrodinger equation for an electron trapped in an infinite potential well. Explain how it results in energy quantization. (CO2,PO1)

(A2) A bullet of mass **40 grams** and an electron both travel with velocity of **1000 m / s**. What wavelengths can be associated with them ? Why the wave nature of bullet is not revealed through diffraction effect ? 6+4(CO2,PO2)

OR

(B) (B1) Explain the concept of wave packet. How this concept leads to Heisenberg uncertainty principle. (CO2,PO1)

(B2) Find the probability that the particle trapped in a rigid box of 'L' wide can be found between **0.45L** to **0.55L** for the second excited state. 6+4(CO2,PO2)

3. (A) (A1) Draw the well labeled diagrams of crystal and band structure for Pure Silicon at $\mathbf{0^0}$K and $\mathbf{300^0K}$. (CO3,PO1)

(A2) The resistivity of doped silicon crystal is $\mathbf{9.27 \times 10^{-3}\ ohm-m}$ and the Hall coefficient is $\mathbf{3.84 \times 10^{-4}\ m^3 / C}$. Assuming the conduction is by a single type of charge carriers ; calculate the density and mobility of carriers. 6+4(CO3,PO2)

OR

(B) (B1) Draw a well labeled diagram to explain Hall effect and hence obtain an expression for Hall coefficient and mobility. (CO3,PO1)

(B2) Intrinsic silicon has resistivity of $\mathbf{2000\ ohm-m}$ at R. T. and the density of conduction electrons is $\mathbf{1.4 \times 10^{16}\ m^{-3}}$. Calculate the resistivity of sample containing acceptor concentration of $\mathbf{10^{21}\ m^{-3}}$. Assume that μ_p remains same as for intrinsic silicon. 6+4(CO3,PO2)

4. (A) (A1) Show that an electron moving with uniform velocity follows a parabolic path in transverse uniform electric field. (CO4,PO1)

(A2) An electron enters the region having $\mathbf{B = 0.2\,k\,(tesla)}$. The initial velocity is $\mathbf{(5i + 2k) \times 10^7\ m/s}$. Find the the pitch and radius of electron trajectory. 4+6(CO4,PO2)

OR

(B) (B1) Explain how a charged particle describes a helical path in a uniform magnetic field. Obtain the expression for radius and time period of the helix. (CO4,PO1)

(B2) In a Van de Graff generator, a proton starts from rest and is accelerated by an electric field of $\mathbf{1.2 \times 10^6\ N/C}$ over a distance of **4 m**.

(i) What is the acceleration of the proton ?

(ii) What is the velocity of the proton at the end of **4 m** ? 6+4(CO4,PO2)

5. (A) (A1) Draw a well labeled block diagram of CRO. Explain how intensity of the trace on the screen is controlled. (CO4,PO1)

(A2) The electric field between the plates of the velocity selector in a Bainbridge mass spectrograph is **1200 V/cm** and the magnetic field in both the regions is **0.6 T**. A stream of singly charge neon ions moves in a circular path of **7.28 cm** radius in the magnetic field. Determine the mass number of the neon isotope. 5+5(CO4,PO2)

OR

(B) (B1) Explain the working of Bainbridge mass spectrograph with a well labeled diagram and show that is has linear mass scale. (CO4,PO1)

(B2) In a certain cyclotron, the maximum radius that path of deuteron may have before it is deflected out of magnetic field of $\mathbf{1.5\ wb/m^2}$ is **20 cm**. Calculate velocity of deuteron. 7+3(CO4,PO2)

6. (A) (A1) Draw well labeled energy level diagrams for three and four level lasers and explain why former is less efficient than later. (CO5,PO1)

(A2) A laser of **10 mW** power has aperture of diameter **d = 3 mm** and emits light of wavelength **7000 Å** If it is focused by a lens of focal length **5 cm**, find the intensity of the beam. 7+3(CO5,PO2)

OR

(B) (B1) Draw energy level diagram of Helium – Neon laser and explain

(i) How Neon atoms get excited to higher energy level ? and

(ii) Why is it necessary to use a tube of narrow diameter ? (CO5,PO1)

(B2) If the half – width of the **10.6 μm** transition of a CO_2 laser is **60 MHz**, calculate the coherence length of the laser. If the cavity length is **2 m**, show that not more than one mode will oscillate. 7+3(CO5,PO2)