B. E. First Semester (All) / SoE – 2018 – 19 Examination

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

Time : 3 Hours] [Max. Marks : 60

Instructions to Candidates :—

(1) All questions are compulsory.
(2) All questions carry marks as indicated.
(3) Due credit will be given to neatness and adequate dimensions.
(4) Assume suitable data wherever necessary.
(5) Diagrams should be given wherever necessary.
(6) Illustrate your answers wherever necessary with the help of neat sketches.
(7) Use of non programmable calculator is permitted.
(8) **List of Constants :**

Planck's Constant $h = 6.625 \times 10^{-34}$ J. s.
Mass of neutron $m_n = 1.67 \times 10^{-27}$ kg
Mass of Proton $m_p = 1.67 \times 10^{-27}$ kg
Charge on electron $e = 1.602 \times 10^{-19}$ C
Mass of electron $m_e = 9.1 \times 10^{-31}$ kg
Charge on proton $= 1.6 \times 10^{-19}$ C
Velocity of light $c = 3 \times 10^{8}$ m / s
Boltzman Const. $K = 1.38 \times 10^{-23}$ J / K.
Mass of Deuteron $M_d = 3.34 \times 10^{-27}$ kg
1 amu $= 1.67 \times 10^{-27}$ kg

1. (A) (A1) Explain the interference pattern obtained in thin film with reflected and transmitted light. Why are they complimentary ? 4(CO1)

(A2) A soap film $\mathbf{5 \times 10^{-5}}$ **cm** thick is viewed at an angle of $\mathbf{35^0}$ to the normal. Find the wavelengths of light in the visible spectrum which will be absent from the reflected light. Refractive index of the film is **1.33**. 4(CO1)

(A3) If the width of the opaque space of grating is doubled to the width the transparent space which order of spectrum will be absent ? 2(CO1)

OR

(B) (B1) Explain the formation of Newton's ring and show that radius of dark rings is proportional to under root of natural number. 4(CO1)

(B2) Show that the angular width of principal maxima of order 'n' is given by

$$d\theta_n = \frac{\lambda}{N(a+b)\cos\theta_n}$$ 3(CO1)

(B3) In Newton's expt. the diameter of 4^{th} and 12^{th} dark rings are 0.40 cm and 0.70 cm respectively. Deduce the diameter of 20^{th} ring. 3(CO1)

2. (A) (A1) What are matter waves ? Can a wave given by the equation $\mathbf{y = A \sin(\omega t - kx)}$ represent a moving particle ? If not explain. 3(CO2)

(A2) An electron is confined to a one dimensional infinitely deep potential well of width $\mathbf{L = 100pm}$.

(a) What is the least energy of the electron ?

(b) How much energy must be transferred to the electron if it is to make a quantum jump from its ground state to second excited state ?. 4(CO2)

(A3) Compare the energy of photon with that of neutron when both are associated with wavelength $1A^0$. 3(CO2)

OR

(B) (B1) Does the concept of Bohr's orbits violate the Heisenberg uncertainty principle ? If Yes, Explain. 2(CO2)

(B2) An electron of mass $\mathbf{9.1 \times 10^{-31}\ kg}$ and a bullet of mass **50 gram** both are traveling with the same velocity of **300 m/sec**. Assume an accuracy of **0.01%** in velocity measurement, calculate the uncertainty in location of their positions. What important inference can be drawn from this result ? 5(CO2)

(B3) Explain why,

(i) ψ must be single valued and continuous function of position and

(ii) The integral of ψ over all space must be equal to unity. 3(CO2)

3. (A) (A1) Show that fermi level lies at the centre of forbidden energy gap in case of intrinsic semiconductor. 3(CO3)

(A2) Draw a graph showing the variation of electron energy levels of Silicon as a function of its inter atomic distance. Explain from it why Silicon is a insulator at 0 K. 4(CO3)

(A3) A current density of $\mathbf{10^3\ A/m^2}$ flows through an n – type Ge crystal which has resistivity of $\mathbf{0.05\ \Omega - m}$. Calculate time taken for electron in materials to drift a $\mathbf{50\ \mu m}$ distance. The mobility of electron is $\mathbf{0.38\ m^2/Vs}$. 3(CO3)

OR

(B) (B1) Classify Conductors, Semiconductors and insulators on the basis of energy band structure. 3(CO3)

(B2) Draw energy band diagram of n – type and p – type semiconductor at 0 K and 300 K indicating the position of Fermi level. 4(CO3)

(B3) N – type Ge sample has donor density of $10^{21}/m^3$. It is arranged in a Hall Effect experiment having magnetic field B = 0.5T and current density J is $500\ A/m^2$. Find the Hall voltage, if the sample is 3 mm wide. 3(CO3)

4. (A) (A1) A particle of charge 'e' and mass m moving with velocity v, is subjected to uniform magnetic field perpendicular to its direction of motion. Show that its period of revolution is independent of velocity. 4(CO4)

(A2) A proton accelerates from rest in a uniform electric field of **500 N / C**. At some time later its speed is **2.5×10^6 m / s.**

(i) Find the acceleration of the proton.

(ii) How long does it take the proton to reach the above velocity ?

(iii) How far has it moved in this time ?

(iv) What is its kinetic energy at this time ? 4(CO4)

(A3) An electron beam from a region of potential 75V into a region of potential 100V making an angle of 45^0 with the direction of electric field. Find the angle of refraction, θ_2. 2(CO4)

OR

(B) (B1) State the conditions under which a charged particle moves on a straight line in

(i) An uniform electric field E

(ii) An uniform magnetic field B

(iii) In a region having both E and B. 3(CO4)

(B2) Show that the velocity acquired by an electron moving along the uniform electrostatic field varies as the square root of potential difference through which it is accelerated. 3(CO4)

(B3) An electron is projected with an initial velocity of 10^7 **m / s** and at an angle 30^0 to the horizontal into a uniform electric field of **5000 N / C**.

(i) Find the maximum height to which electron rises vectically. (CO4)

(ii) After what horizontal distance does the electron return to its original elevation ? 4(CO4)

5. (A) (A1) Draw the block diagram of CRO. Discuss the function of time base circuit. 4(CO5)

(A2) A waveform observed on a CRT screen shows amplitude of 300 mv. If the time / div switch is set to 10 μs and the horizontal spread of the wave is 3. Determine the frequency, V_{p-p}, Vrms, Vave of the signal. 3(CO5)

(A3) In a Bainbridge mass spectrograph, the electric field used is 8×10^4 V / m, the magnetic field common to both places is 0.55 Wb / m^2. If the ion source consists of singly ionized neon isotopes of atomic masses 20 and 22, calculate linear separation of lines formed on the photographic plate. 3(CO5)

OR

(B) (B1) Explain the function of velocity selector in Bainbridge mass spectrograph. Obtain an expression for linear spearation in it. 4(CO5)

(B2) Protons are accelerated in a small cyclotron. The magnetic field strength is 1.3 wb / m^2 and the radius of the last semicircle is 0.5 m.

(i) What must be the frequency of the oscillator supplying the power of the Dees ?

(ii) What is the final energy acquired by the proton ? 3(CO5)

(B3) A cyclotron with its Dees of radius 2 m has a magnetic field of 0.75 Wb / m^2. Calculate the maximum energies to which

(i) Protons and (ii) Deuterons can be accelerated. 3(CO5)

6. (A) (A1) Discuss the following points in Ruby Laser and He – Ne Laser.

(a) Active Medium (b) Pumping method. 4(CO6)

(A2) 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. 2(CO6)

(A3) Find the relative population of two states in Ruby laser that produces a light beam of $6943A^0$ at 300 K and 500 K. 4(CO6)

OR

(B) (B1) Explain different processes occurring during interaction of radiation with matter. Which process is required to enhance in laser operation ? Why ? 5(CO6)

(B2) Why is Ruby laser likely to be less efficient than a four level laser ? Explain. 2(CO6)

(B3) A ruby laser emits light of wavelength 694.4 nm. If a laser pulse is emitted for 1.2×10^{-11} s and energy released per pulse is 0.15 J

(i) What is the length of the pulse ? and

(ii) How many photons are there in each pulse ? 3(CO6)