

Total No. of Questions : 8]

SEAT No. :

PC1676

[6351]-102

[Total No. of Pages : 3

F.E.

ENGINEERING PHYSICS

(2019 Pattern) (Semester- I/II) (107002) (Credit System)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Neat diagrams must be drawn wherever necessary.
- 2) Figures to the right indicate full marks.
- 3) Use of logarithmic tables slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.
- 4) Assuem Suitable data, if necessary.

Constants:

Mass of electron =  $9.1 \times 10^{-31}$  kg.

Charge on electron =  $1.6 \times 10^{-19}$  c

Velocity of light =  $3 \times 10^8$  m/s

Planck's Constant =  $6.63 \times 10^{-34}$  J.s

- Q1) a) State de Broglie hypothesis. Derive de Broglie's wavelength in terms of kinetic energy E and Potential difference V. [6]
- b) What is normalisation condition, the wavefunction must satisfy? Write down the other conditions the wave function must satisfy. [4]
- c) Show that the energy of a particle in an infinite potential well is quantised by giving the expression of energy and with energy level diagram. [4]
- d) An electron is confined to a box of length 2 Å. Calculate the minimum uncertainty in its velocity. [4]

OR

- Q2) a) Derive Schrodinger's time independent wave equation. [6]
- b) Using  $\Delta x \Delta p = h$ , prove Heisenberg's uncertainty relation of energy and time. [4]
- c) Write down any four properties of matter waves. [4]
- d) An electron is trapped in an infinite potential well of width 1Å calculate the lowest two permissible energies (in eV) the electron can have. [4]

P.T.O.

- Q3)** a) Explain Hall Effect. Derive the equation for Hall voltage. [6]  
 b) What is Fermi-Dirac Probability distribution function. Write the terms involved in the equation. Draw the Energy diagrams with Fermi energy level for intrinsic and extrinsic semiconductors at  $0^\circ\text{K}$ . [4]  
 c) Draw the I-V characteristics of solar cell and define the terms; [4]  
 i) Fill factor  
 ii) Open circuit voltage  
 iii) Short circuit current  
 d) Calculate the energy gap in silicon if it transparent to a radiation of wavelengths greater than or equal to  $11,000 \text{ \AA}$ . [3]

OR

- Q4)** a) By using energy band theory of solids explain classification of solids into conductors, semiconductors and insulators. [6]  
 b) Draw the energy band diagrams for Forward and Reverse biasing of the P-N junction diode. [4]  
 c) Write down the expression for conductivity of a semiconductor. Using this, find the expressions for, intrinsic semiconductors and extrinsic semiconductor. [4]  
 d) Calculate the number of acceptors to be added to a Germanium sample to obtain the resistivity of  $10\Omega\text{-cm}$ . Given  $\mu = 17000 \text{ cm}^2/\text{V}\cdot\text{sec}$ . [3]

- Q5)** a) Explain the origin of magnetism in brief Differentiate between paramagnetic materials and diamagnetic materials on the basis of magnetic susceptibility & magnetic permeability. [6]  
 b) Explain Meissner effect. Show that superconductors are diamagnetic in nature. [4]  
 c) Explain the following terms: [4]  
 i) Critical magnetic field  
 ii) Persistent current  
 d) The critical temperature for lead is  $7.2\text{K}$ . However at  $5\text{K}$  it loses its superconductivity when subjected to a magnetic field of  $3.3 \times 10^4 \text{ A/m}$ . Find the maximum value of critical magnetic field which will allow the metal to retain its superconductivity at  $0^\circ\text{K}$ . [4]

OR

- Q6)** a) Explain superconductivity. Differentiate between Type I & Type II superconductors (Any 4 pts). [6]  
 b) Explain in brief the process of magnetic recording and retrieving. [4]  
 c) What is magnetic permeability. Find the relation between relative permeability ( $\mu_r$ ) and magnetic susceptibility ( $\chi$ ). [4]  
 d) The critical field of Niobium is  $1 \times 10^5 \text{ A/m}$  at  $8\text{K}$  and  $2 \times 10^5$  at  $0 \text{ K}$ . calculate the critical temperature of the element. [4]

- Q7)** a) What is meant by Non-destructive testing. Explain Acoustic Emission testing technique. [6]
- b) Explain optical and electrical properties of nanoparticles in brief. [4]
- c) Differentiate between Destructive and Non-destructive testing techniques. [4]
- d) Find the echo time of ultrasonic pulse which is travelling with the velocity of  $3.1 \times 10^3$  m/s in a sheet of mild steel of thickness 9 mm. [3]

OR

- Q8)** a) What is Nanotechnology? Explain briefly the variation in properties of nanoparticles on the basis of [6]
- i) Surface area to volume ratio
- ii) Quantum confinement Effect.
- b) State any two applications of nanoparticles in [4]
- i) Automobiles and
- ii) Medicine
- c) Explain flaw detection method using ultrasonic testing. [4]
- d) An ultrasonic pulse is sent through a copper block and echo is recorded after 4  $\mu$ s. If velocity of ultrasonic waves is 5000 m/s, calculate the thickness of the copper block. [3]

