[6001]-4002

F.E.

ENGINEERING PHYSICS

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

Time : 2½ Hours]   *[Max. Marks : 70*

Instructions to the candidates :

1) *Question No. 1 is compulsory.*
2) *Q.No. 2 to Q.No. 9 carry equal marks.*
3) *Figures to the right indicate full marks.*
4) *Assume suitable data, if necessary.*
5) *Use of electronic calculator is allowed.*

Physical Constants :

1) *Mass of electron* $m_e = 9.1 \times 10^{-31} kg$
2) *Charge on electron* $e = 1.6 \times 10^{-19} c$
3) *Planek's constant* $h = 6.63 \times 10^{-34} J\text{-}sec.$

Q1) Write correct option of given questions with Answer. (1 mark each) :   **[10]**

i) According to Dr. Broglies hypothesis, the wavelength $\lambda = \dfrac{h}{p}$ is applicable for

     a) Photons
     b) Matter particles
     c) Either matter particles or photons
     d) Both matter particles and photons

ii) According to Heisenberg's uncertainty principle -

     a) $\Delta x.\Delta p \geq \dfrac{h}{2n}$ b) $\Delta x.\Delta p \leq \dfrac{h}{2n}$

     c) $\Delta x.\Delta p \geq \dfrac{h}{6n}$ d) $\Delta x.\Delta p \leq \dfrac{h}{4n}$

iii) In Schrodinger's time independent equation _____ of a particle is independent of time.

   a) Kinetic energy   b) Potential energy

   c) Total energy   d) Wave function

iv) Fermi level for a metal or conductor is highest energy level occupied by electrons at _____.

   a) 0^oC b) 0^oF

   c) 0^oK d) None of the above

v) Hall effect is true for _____.

   a) Metals only

   b) Semiconductors only

   c) For N-type semiconductors only

   d) Both metal and semiconductors

vi) The magnetic materials exhibit the property of magnetisation because of _____.

   a) Orbital motion of electrons   b) Spin of electrons

   c) Spin of nucleus   d) All of the above

vii) A superconductor is a perfect _____ material.

   a) Insulator   b) Semiconductor

   c) Dielectric   d) Diamagnetic

viii) Tunneling of Cooper pairs through an insulating layer between two superconductors is called _____.

   a) Josephson effect   b) Onnes effect

   c) Meissner effect   d) Kerr effect

ix) With increase in size of nanoparticles its hardness _____.

   a) Increases   b) Decreases

   c) Remains same   d) Difficult to predict

x) In Non destructive testing (NDT) the physical and chemical properties of sample _____.

   a) Changes   b) Do not changes

   c) Depends on temp   d) Does not depend on temp

Q2) a) Deduce Schrodinger's time independent wave equation. **[6]**

b) State and explain Heisenberg's uncertainty principle using the except of small and large wave packet. **[5]**

c) Calculate the energy difference between the ground state and first excited state of an electron in the rigid box of length 1A°. **[4]**

OR

Q3) a) State De Broglie's hypothesis. Derive an expression for De Broglies wavelength of an elctron accelerated by a potential difference of 'V'.**[6]**

b) Define wave function. Write the conditions of well behaved wave function. **[5]**

c) The uncertainty in the location of a particle is equal to its De Broglie wavelength. Show that the uncertainty in the velocity to a particle is equal to the particle velocity itself. **[4]**

Q4) a) With the help of bond theory of solids explain the classification of solids into conductors, semiconductors and insulators. **[6]**

b) What are solar cells? Draw I-V characteristics of solar cells and define the terms i) Short circuit current and ii) Open circuit voltage. **[5]**

c) The Hall coefficient of a specimen of a doped silicon is found to be $3.66 \times 10^{-4} \, m^3/c$. The resistivity of the specimen is $1 \times 10^{-2} \, \Omega m$. Determine the mobility of the charge carriers. **[4]**

OR

Q5) a) Explain the Hall effect with a neat labelled diagram. Derive an expression for Hall voltage. **[6]**

b) Define Fermi level in semiconductors. For a P-N junction diode draw energy band picture showing the position of Fermi level in i) Zero bias and ii) Forward bias. **[5]**

c) Calculate the number of donors atoms which must be added to an intrinsic semiconductors to obtain the resistivity of $10^{-6} \, \Omega cm$. (Given mobility of electrons = 1000 cm^2/V sec.) **[4]**

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Q6) a) Differentiate between diamagnetism, paramagnetism and ferromagnetism. (Any two points) **[6]**

b) Define : **[5]**

   i) Magnetic permeability and

   ii) Magnetic susceptibility.

   Obtain the relation between them.

c) The critical magnetic field of niobium is 1×10^5 A/m at 8°K and 2×10^5 A/m at 0°K. Calculate the critical temperature of the element. **[4]**

OR

Q7) a) Explain artificial magnetic field in brief. Distinguish between Type-I & Type II superconductors. (Any 3 points). **[6]**

b) Explain Meissner effect in brief. Show that superconductors are characterised by perfect diamagnetism. **[5]**

c) Define the terms : **[4]**

   i) Magnetic field strength (H)

   ii) Magnetic induction (B)

   iii) Magnetisation (M)

   iv) Relation permeability (μ_r)

OR

Q8) a) What is echosounding technique? Using this technique explain non destructive testing for the measurement of thickness of a metal sheet using ultrasonic waves. **[6]**

b) What is Non Destructive Testing (NDT)? Distinguish between Non Destructive Testing and Destructive Testing. (Any two points) **[5]**

c) Write any four applications of nanotechnology in the field of automobile. Explain any one in brief. **[4]**

OR

Q9) a) Explain optical and mechanical properties of nanoparticles. **[6]**

b) What are nanoparticles? What is the effect of quantum confinement on the properties of nanoparticles? **[5]**

c) An ultrasonic pulse is sent through a copper block. The echo pulse is received after 4 µs. If velocity of ultrasonic in copper is 5000 m/s, calculate the thickness of copper block. If the reflection pulse recorded after 1.253 µs from the top what is the location of flaws? **[4]**

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