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SEAT No. : ____

PA-4295

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F.E.

ENGINEERING PHYSICS

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

Time : 2½ Hours] ***[Max. Marks :70***

Instructions to the candidates:

1) ***Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7or Q8.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right side indicate full marks.***
4) ***Use of logarithmic tables slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.***
5) ***Assume suitable data, if necessary.***

Physical Constants :

1) **Mass of Electron (M_e) = 9.1×10^{-31} kg**
2) **Charge on Electron (e) = 1.6×10^{-19} C**
3) **Mass of Proton (M_p) = 1.673×10^{-27} kg**
4) **Mass of neutron (M_n) = 1.673×10^{-27} kg**
5) **Velocity of light (c) = 3×10^{8} m/s**
6) **Plank's constant (h) = 6.63×10^{-34} J.s**

Q1) a) What is the significance of Schrodinger's equation? Derive schrodinger's time independent equation. **[6]**

b) Derive the expression for de Broglie wavelength for a particle when it is moving with kinetic energy 'E'. **[4]**

c) With a schematic diagram, explain in brief the principle of scanning tunneling microscope. **[4]**

d) If a proton is moving with velocity 2% of the velocity of light, calculate de Broglie wavelength. **[4]**

OR

Q2) a) For a particle trapped in one-dimensional rigid box (infinite potential well), derive the equation for its energy. Explain in brief why this energy is quantized. **[6]**

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b) For an electron accelerated by potential difference V, derive the expression for its de Broglie wavelength. **[4]**

c) What is de Broglie hypothesis of matter waves? Explain in brief why matter waves are neither electromagnetic nor mechanical waves. **[4]**

d) An electron is trapped in an infinite potential well of width 1.75Å. Calculate energy difference between ground and first energy level. **[4]**

Q3) a) Explain Hall effect with suitable diagram. Derive the expression for Hall voltage and Hall coefficient. **[6]**

b) Draw a neat and labelled diagram showing I-V characteristics of a solar cell. Write the equations for fill factor and efficiency of solar cell. **[4]**

c) Define Fermi level in metals. Write Fermi-Dirac probability distribution function and explain the meaning of each term. **[4]**

d) Calculate number of donar atoms which must be added to an intrinsic semiconductor to obtain a resistivity of 12 ohm-cm (Mobility of electrons, μ_c = 500 $cm^2/V.S$. **[3]**

OR

Q4) a) Explain classification of solids into conductors, semiconductors and insulators on the basis of band theory. **[6]**

b) Define Fermi level in semiconductor. Draw neat & labelled diagram showing position of Fermi level in instrinsic, N-type and P-type semiconductors. **[4]**

c) State the advantages (any two) and applications (any two) of solar cell. **[4]**

d) An N type semiconductor has a thickness 0.12 mm and a current of 1mA is flowing along its length. When a magnetic field of 1.5 T is applied along its thickness, calculate voltage developed across its width. [Hall coefficient, $R_H = 3.68 \times 10^{-4}\ m^3/C$] **[3]**

Q5) a) On the basis of orbital and spin motion of electron and spin motion of nucleus, explain origin of magnetism. **[6]**

b) Define (i) magnetic field strength (ii) magnetic induction (iii) magnetic permeability. Write relation between them **[4]**

c) What is super conductivity? Differentiate between type I & type II super conductors (any three). **[4]**

d) The transition temperature T_e for lead is 7.26 K. The critical magnetic field at 0K i.e. $H_c(0)$ is 8×10^5 A/m. It is to be used as a super conductor subjected to a magnetic field $H_c(T)$ of 4×10^4 A/m. At what maximum temperature T, it can be operated without losing its superconductivity. **[4]**

OR

Q6) a) Explain Meissner effect in brief. What is the cause of Meissner effect? Show that super conductors exhibit perfect diamagnetism. **[6]**

b) What is magnetic permeability (μ) & magnetic susceptibility (χ). Obtain relation between them. **[4]**

c) Differentiate between diamagnetism and ferromagnetism (Any two points) **[4]**

d) For Niobium, if critical temperature T_c is 11.3 K and critical magnetic field at 0K is. $H_c(0)$ is 2×10^5 A/m, Calculate critical magnetic field $H_c(T)$ at T = 4.2K. **[4]**

Q7) a) Explain electrical and mechanical properties of nanoparticles. **[6]**

b) Write applications of nanotechnology in the field of electronics. Explain any one application in brief. **[4]**

c) What are ultrasonic waves? An ultrasonic wave of velocity 6400 m/s is sent through the top of an aluminium block of thickness 4.5 cm. It is reflected back from the internal flaw. After what time echo would be obtained. **[4]**

d) Explain in brief, the principle of radiography testing technique. **[3]**

OR

Q8) a) What is Non-Destructive Testing (NDT)? State objectives of NDT (any two). State advantages of NDT over DT (any two). **[6]**

b) Write applications of nanotechnology in the field of automobiles. Explain any one application in brief. **[4]**

c) What are ultrasonic waves? An ultrasonic wave is sent through a block of steel and its echo is received after 1.5 μs. if velocity of ultrasonic waves is 5890 m/s, determine location of the flaw. **[4]**

d) Explain optical properties of nanoparticles. **[3]**