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[4756]-23

F.E. (Second Semester) EXAMINATION, 2015

APPLIED SCIENCE—II

PHYSICS

(2008 PATTERN)

Time : Two Hours

Maximum Marks : 50

N.B. :— (i) Answer Q. No. 1 *or* Q. No. 2, Q. No. 3 *or* Q. No. 4,
Q. No. 5 *or* Q. No. 6.

(ii) Neat diagrams must be drawn wherever necessary.

(iii) Figures to the right indicate full marks.

(iv) Use of logarithmic tables, Slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.

(v) Assume suitable data, if necessary.

Constants : $h = 6.63 \times 10^{-34}$ J.sec

$$c = 3 \times 10^8 \text{ m/s}$$

$$e = 1.6 \times 10^{-19} \text{ C}$$

$$m_e = 9.1 \times 10^{-31} \text{ kg.}$$

1. (a) State and explain properties of matter wave. Show that the wavelength associated, with an electron, accelerated by a potential difference of V volts, is given by $\frac{h}{\sqrt{2meV}}$. [7]

P.T.O.

- (b) State and explain Heisenberg's uncertainty principle. Illustrate it by an experiment on electron diffraction at a single slit. [6]
- (c) De Broglie wavelength of electrons in a monoenergetic beam is 7.2×10^{-11} m. Calculate the momentum and energy of electrons in the beam in eV. [4]

Or

2. (a) Derive the Schrödinger's time independent wave equation. [7]
 - (b) What is a wave group ? Show that the group velocity of a matter wave is equal to the particle velocity. [6]
 - (c) Compute energy difference between the ground state and first excited state for an electron in 1-dimensional rigid box of length 10^{-8} cm. [6]
3. (a) Explain the construction and working of Ruby laser with neat labelled diagram. [7]
 - (b) What is superconductivity ? Explain Meissner's effect. [6]
 - (c) Explain any *two* applications of the superconductors. [4]

Or

4. (a) Explain with neat diagram principle, construction and working of He-Ne laser. [7]

(b) Explain type-I and type-II superconductor. [6]

(c) Explain : [4]

(i) Population Inversion

(ii) Pumping Mechanism.

5. (a) Explain with neat diagram any *one* method of synthesis of nano-particles. [6]

(b) State and explain Hall effect. Obtain an expression for Hall voltage. [6]

(c) Calculate the mobility of charge carriers in doped silicon whose conductivity is 100 per $\Omega\text{-m}$ and the Hall coefficient is $3.6 \times 10^{-4} \text{ m}^3/\text{C}$. [4]

Or

6. (a) Explain any *two* properties of nano-materials. [6]

(b) Using the Fermi-Dirac probability distribution function, derive the position of Fermi level in the intrinsic semiconductor. [6]

(c) Discuss applications of Nanotechnology in the field of Medical and Electronics. [4]