15014

B. Tech 1st Semester Examination

Engineering Physics-I (NS)

NS-102

Time : 3 Hours   Max. Marks : 100

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : Attempt five questions in all. Section A, B, C and D consist of 2 questions and students are advised to attempt at least one question from each of the sections. Section-E is compulsory consisting of 10 questions carrying 2 marks each. Where necessary, draw an appropriate diagram?

SECTION - A

1. (a) What are Newton's rings? Derive an expression for determining the wavelength of light using Newton's rings. How Newton's rings apparatus is used to find the refractive index of the liquid?

   (b) A parallel beam of monochromatic light of wavelength 5000Å is incident normally on a plane diffraction grating having 4000 lines/cm. Calculate the angle of diffraction for the first order principal maxima. What other higher order of diffraction are possible with this grating?

   (c) Explain the phenomenon of double refraction in a calcite crystal. What do you understand by ordinary and extraordinary ray of light?   (8+6+6=20)

2. (a) How are plane polarized, elliptically polarized and circularly polarized light produced? Define quarter wave plate, half wave plate and full wave plate.
                                                              [P.T.O.]

   (b) In case of single slit diffraction, explain what happens *when* slit width is gradually increased and also when the screen is *gradually* moved away from the slit.

   (c) What is grating element of a diffraction grating? What particular spectra would be absent if the width of transparencies is equal to opacities?   (8+6+6=20)

SECTION - B

3. (a) What is Compton effect? Derive an expression for Compton shift.

   (b) (i) If the de-Broglie wavelength of an electron is 9×10^{-10} m, calculate its kinetic energy.

        (ii) Distinguish between phase velocity and group velocity.

   (c) What do you understand by Heisenberg uncertainty principle? Use this to explain the non-existence of electron inside the nucleus.   (8+6+6=20)

4. (a) What are matter waves? Write down its characteristics. Show that de-Broglie wavelength associated with a particle of mass m and kinetic energy E is given by $\lambda = \dfrac{h}{\sqrt{2mE}}$.

   (b) State Maxwell's theory of electromagnetic waves. List various features of electromagnetic waves.

   (c) When X-rays of energy 100 keV strikes a target, they are scattered at an angle 30°. Find the energy of recoiled electrons.   (8+6+6=20)

SECTION - C

5. (a) Use Schrodinger wave equation for a particle in a 1D box to obtain eigen function and eigen values.

(b)   Determine the probabilities of finding a particle trapped in a box of length L in the region from 0.30L to 0.65L for the first excited state.

(c)   Draw wave functions and probability density functions for particle trapped in a box of length L for ground state, 1st excited state and 2nd excited state.   (8+6+6=20)

6. (a)   Solve Schrodinger wave equation for harmonic oscillator and hence write the eigen values for harmonic oscillator.

(b)   (i)   Comment on the statement "Energy of trapped particle in a box is quantized".

(ii) What do you mean by zero-point energy?

(c)   What are the dimensions of the wave function'? What is the significance of normalization of wave function?
                                                (8+6+6=20)

SECTION - D

7. (a)   What is the significance of mass defect and binding energy in defining the mass of the nucleus? How these quantities are related?

(b)   Calculate the binding energy of lithium nucleus. Given mass of proton 1.00814amu, mass of neutron 1.00893amu and mass of lithium nucleus 7.01822amu.

(c)   (i)   Compare the properties of leptons and baryons.

(ii) Differentiate between π-mesons and μ-mesons.
                                                (8+6+6=20)

8. (a)   (i)   Why nuclear fusion is more difficult than nuclear fission?

(ii) What is chain reaction'? Explain how it is used to obtain a controlled source of energy.   **[P.T.O.]**

(b)   Explain the salient features of primary cosmic rays. Differentiate between primary and secondary cosmic rays.

(c)   Calculate the energy required to create a proton-antiproton pair.   (8+6+6=20)

SECTION - E

9. (a)   What are the coherent sources of light? Is it possible to obtain coherent sources from two separate sources? If not, why?

(b)   Why don't we see interference patterns if we look at a glass window?

(c)   If the plane of vibration of the incident beam makes an angle of 30° with the optic axis, compare the intensities of ordinary and extraordinary rays

(d)   Write down Maxwell's equations in differential form.

(e)   What is the significance of wave function, ψ and its square $|\psi|^2$?

(f)   What do you understand by wave packet?

(g)   Does harmonic oscillator in quantum mechanics explain the tunneling phenomena for a particle in a box? Explain.

(h)   Why nuclear forces can not be of gravitational or electromagnetic type?

(i)   List various nuclear reactions that occur in solar energy.

(j)   Explain particle and anti-particle.   (10×2=20)