Ref. No.: EX/ET/Ph/T/2B/126/2018

B.E. ELECTRONICS AND TELE-COMMUNICATION ENGINEERING

FIRST YEAR, SECOND SEMESTER EXAM 2018

Subject: PHYSICS IIB Time: Three Hours Full Marks: 100

Answer any **five** questions.

1. (a) What is a zone plate? Show that a zone plate acts as a converging lens. How does it differ from a convex lens?
   (b) Discuss how you can use interference to determine the thickness of a very thin mica sheet.
   (c) If the amplitudes of two coherent light waves are in the ratio 1:4, calculate the ratio of the maximum and minimum intensity in an interference pattern.

   [(2+6+2)+6+4]

2. (a) Derive an expression for the intensity at a point in the Fraunhofer type of diffraction produced by a single slit illuminated by monochromatic light. Plot the intensity distribution profile.
   (b) What do you mean by absent spectra in a grating? Discuss the conditions for absent spectra.
   (c) What is the highest order of spectrum which may be seen with sodium light of wavelength 5000 Å by means of a grating with 3000 lines per cm?

   [(10+2)+4+4]

3. (a) What is Compton Effect? Explain. What is its significance?
   (b) Explain de-Broglie's wave. Calculate the de Broglie wavelength associated with an electron subjected to a potential difference of 1000 volt.
   (c) State and explain Heisenberg's uncertainty principle. For a hydrogen atom of radius 5.3×10^{-11} m, use the uncertainty principle to estimate the minimum energy an electron can have in this atom.

   [(8+2)+5+5]

4. (a) State the postulates which led to Bohr's theory of line spectra.
   (b) Derive an expression for energy of radiation when an electron jumps from one orbit to another in a hydrogen like atom.
   c) Explain the origin of continuous and characteristic X-ray spectra. What is meant by K_α line?
   (d) An X-ray tube is operated at 100 kV. Calculate the minimum wavelength produced in the X-ray spectra. What is the corresponding frequency? [4+ 5+ 6+5]

[Please turn over]

B.E. Electronics and Telecommunication Engineering Examination-2018.

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Paper- PHYSICS-IIB

TIME 3 Hours Full Marks 100

Answer any five questions (5×5=25).

All parts of a question must be written in a single place.

5. (a) Write down the Schrödinger equation for Hydrogen atom in spherical polar coordinate. Take trial solution as $R(r)\Theta(\theta)\Phi(\phi)$ and separate each part. Give the solution of Φ equation.
(b) Give the eigen operator and eigen value of $\hat{L_z}$.
(c) Show that $[L_x, L_y] = i\hbar L_z$.
(d) Show that the eigen values of a Hermitian operator is real and eigen vectors corresponding to different eigen values are orthogonal to each other. [6+4+4+(3+3)]

6. (a) Solve the Schrödinger equation for 1-dimensional potential well defined by

$$V(x) = 0 \quad 0 \leq x \leq L$$
$$= \infty \quad x < 0 \ \& \ x > L$$

Find out the energy eigen states at different energy levels. Further plot the eigen functions on the different energy levels. So that they are orthogonal to each other.
(b) Consider the Gaussian wave packet

$$\Psi(x) = A \exp(ikx - \frac{x^2}{2d^2})$$

Normalize the wave function.
Further show that $< (\Delta x)^2 >< (\Delta p)^2 >= \frac{\hbar^2}{4}$ [(5+3+2)+(2+4+4)]

7. (a)Calculate the probability density and probability current density for a wave function $\Psi(x) = A \exp(\frac{-\sigma^2 x^2}{2}) \exp(ikx)$
(b) Evaluate $[\hat{x}, \hat{p}^n]$, $[\hat{x}, [\hat{x}, H]]$
(c)Show that Schrodinger equation is linear.
(d) Prove that parity operator is of eigen value ± 1.
(e) Show that for a potential $V(-x) = V(x)$, the wave function must have a definite parity. [5+5+3+3+4]