City College

3rd Semester Internal Examination 2020-21

Physics (Hons)

Paper: PHS-A-CC-3-7-TH (Modern Physics)

Time- 1 hour **Full Marks-20**

Answer any ten questions. 10×2=20

1. What is the De Broglie wavelength of an electron moving with velocity $v = \frac{3}{5}c$?
2. Calculate the Compton wavelength of an electron.
3. Use the uncertainty principle to show that an electron cannot be a constituent of nucleus.
4. Examine if the operator $\hat{A}$ is linear: $\hat{A}\psi(x) = \psi^*(x)$
5. Evaluate the commutator $[\hat{x}, \hat{p}_x{}^2]$.
6. Show that the eigenvalues of a Hermitian operator are real.
7. A one dimensional wave function is given by $\psi(x) = \sqrt{a}e^{-ax}$. Find the probability of finding the particle between $x = \frac{1}{a}$ and $x = \frac{2}{a}$.
8. Two deuteron nuclei undergo nuclear fusion to form a helium nucleus. Mass of ${}_1H^2 = 2.014102u$, mass of ${}_2He^4 = 4.002604u$. Calculate the energy released in fusion in MeV.
9. What is proton-neutron hypothesis?
10. How were the difficulties in explaining β ray energy spectrum removed with the help of neutrino hypothesis?
11. Calculate the binding fraction for ${}_8O^{16}$, given $M({}_1H^1) = 1.007825u$, $M({}_0n^1) = 1.008665u$, $M({}_8O^{16}) = 15.994915u$ and 1u=931.5MeV.
12. What are the different methods of achieving population inversion for producing a laser beam?

------End of Question Paper------

E-mail the scanned copy of answer script to **sem3hcityphysics@gmail.com** within **15 minutes** after the end of the examination.