2021
B.A./B.Sc.
Third Semester
GENERIC ELECTIVE
PHYSICS
Course Code: PHG 3.11
(Elements of Modern Physics)

PART–B
Total Mark: 30

Answer the following questions.

1. (a) Prove that in the photo-electric effect from a metal surface, the maximum velocity of the photo-electrons is related to the stopping potential by the equation $V_{max} = 5.927 \times 10^5 \sqrt{V_0}$ where V_{max} is in *m/sec*. and V_0 is in volts. 3

   (b) Show that the de Broglie wavelength associated with an electron of energy V electron-volts is approximately $1.227/\sqrt{V}$ *nm*. 3

2. (a) State any two postulates of quantum mechanics. 2

   (b) Find the normalization constant of the particle described by the Gaussian wave packet wave function $\psi(x) = Ae^{\frac{\alpha^2 x^2}{2}} e^{ikx}$. 4

3. (a) Find the lowest energy of a neutron confined to a nucleus of size $10^{-14} m$. Given mass of neutron is $1.67 \times 10^{-27}\, kg$. 3

   (b) Derive an approximate expression for the transmission coefficient for a rectangular potential barrier for which $\dfrac{a}{\hbar\sqrt{2m(V_0 - E)}} \gg 1$ 3

4. (a) A hydrogen atom is $5.3 \times 10^{-11} m$ in radius. Use the uncertainty principle to estimate the minimum energy an electron can have in this atom. 3

   (b) Life time of a nucleus in the excited state is $10^{-12} s$. Calculate the probable uncertainty in energy and frequency of a γ-ray photon emitted by it. 3

5. (a) The half life of radon is 3.8 days. After how many days will 1/10 of a radon sample remain behind? 3

   (b) Polonium-212 emits alpha particles whose kinetic energy is 10.54 MeV. Determine the alpha disintegration energy. 3

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