B. N. Bandodkar College of Science, Thane.
Department of Physics

T.Y.B.Sc: Physics: Paper-III

Duration: 3 hrs Total Marks: 100

N.B. (1) Figures to the right indicate full marks.
(2) All questions are compulsory.
(3) Use of non programmable calculator is allowed.
(4) Symbols have their usual meaning unless stated otherwise.

Q.1. Attempt any **TWO.**

a) By operator method, solve the Schrodinger's equation of linear harmonic oscillator and obtain Eigen functions and Eigen values. **10**

b) Discuss Stern-Gerlach experiment. What does it explains? Which element is chosen for the experiment? Why? **10**

c) Derive the selection rule for magnetic quantum number of Hydrogen atom. Comment on the result. **10**

Q.2. Attempt any **TWO.**

a) What is Anomalous Zeeman effect? Explain it with the help of a J-level. **10**

b) Derive expressions for moment of inertia and rotational energy states of diatomic molecule, assuming rigid rotator approximation. Explain how energy levels get modified if effect of bond elongation of a non-rigid molecule is taken into consideration. **10**

c) What is Raman scattering? Give Classical explanation of Raman effect. **10**

Q.3. Attempt any **TWO.**

a) Sketch the α- particle trajectory produced by a gold nucleus considered as a sphere of radius R in the Rutherford's α – scattering experiment. Obtain an expression for the nuclear radius.
Hence deduce the value of R for gold nucleus if Z = 79 and mass of α- particle , $m = 6 \times 10^{-27}$ kg , velocity of α – particle ,$v = 10^{7}$ m/s. **10**

b) Explain the construction and working of Cowan & Reines neutrino detection experiment , to prove the existence of the neutrino. **10**

c) What is Mossbauer effect? Enlist four Mossbauer emitters. Describe a typical Mossbauer experimental set up and show the decay of $^{191}_{76}Os$ to $^{191}_{77}Ir$. **10**

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Q.4. Attempt any **TWO.**

a) State Weizsacher's semi-empirical mass formula based on the liquid drop model and explain in brief the terms involved. Hence obtain an equation of a mass parabola. **10**

b) Discuss the neutron cycle in a nuclear reactor to obtain the four factor formula for a finite size of an assembly of a nuclear reactor. Give significance of reproduction factor k. **10**

c) Describe the construction and working of a bubble chamber. State its advantages.

Q.5. **(A)** Attempt any **THREE.**

(1) For a d-electron, draw space quantization diagram. Also calculate cosine of angle between each orientation of $\vec{L}$ and Z-axis. **05**

(2)state Frank-Condon principal. Briefly explain predissociation. **05**

(3) Define nuclear disintegration energy of spontaneous α –decay.

Show that $Q_\alpha = K_\alpha \left(\frac{m_\alpha}{M_d} - 1 \right)$

Hence explain how the α – particle carries away most of the disintegration energy. **05**

(4) Calculate the amount of energy available in mega watt - day if 1 kg of ^{235}U is completely fissioned. **05**

(B) Attempt any **ONE.**

(1)For $^3P_1$ state, write the values of J, L, and S. find the angle between $\vec{L}$ and $\vec{S}$. **03**

(2) State the postulates of the Pauli's neutrino hypothesis. **03**

(C) Attempt any **ONE.**

(1) Why anti-Stokes lines are weaker than Stokes line. **02**

(2) What are delayed neutrons? State their use in a nuclear reactor. **02**

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