

PRABHAT KUMAR COLLEGE, CONTAI

M. Sc. 3rd Semester Examination-2021

Subject: Physics Paper: PHS 302 Full Marks: 50 Time: 2 hr

302.1: Molecular Spectroscopy & Laser Physics

Answer any TWO questions

2×10=20

- (a) Deduce the expression for the wave number of various rotational states of a di-atomic molecule assuming to be rigid one. (b) Draw the energy levels and associated transitions mentioning the selection rule. 6+4
- (a) Find the value of J for which the number of molecules in that state becomes maximum in case of rotational spectra of diatomic rigid rotator. (b) Explain the effect of isotope on the rotational bands. (c) How the rotational levels change in case of a non-rigid rotator. 3+3+4
- (a) Deduce the expression for the wave number of a diatomic vibrating rotator considering the anharmonicity in the vibration. (b) Draw the energy levels and associated transitions mentioning the selection rules. 6+4
- (a) What is Raman scattering? (b) Discuss the origin of Stokes' and anti-Stokes lines associated with the Raman scattering from a molecule. (c) Which type of molecules usually response in Raman scattering? 2+6+2

Internal Assesment-05

302.2: Nuclear Physics-I

Answer any TWO questions

- (a) Is α -energy spectrum a discrete or continuous spectrum? Explain. (b) Discuss Geiger-Nuttal law. (c) Using Gamow's theory of α -decay, obtain an expression for the decay constant λ . (2+2+6)
- (a) Discuss neutrino hypothesis of β -decay. (b) What is Kurie plot? Write down its significance. (c) Using Fermi's theory of β -decay, find out the probability of electron (β -particle) emission per unit time in the momentum range P_e and $P_e + dP_e$. (2+2+6)
- (a) What is internal conversion? Define internal conversion coefficient. (b) What are the multipole characters of γ -radiations? (c) Write down the angular momentum and parity selection rules for γ -decay. (d) ^{226}Ra decays by emitting two groups of α -particles of energies 4.785 and 4.602 MeV. The daughter nucleus ^{222}Rn also emits a γ -ray of energy 186 keV. Use this information to sketch the decay scheme. You may assume that the most energetic α -particle leaves the daughter nucleus in its ground state. (2+2+2+4)
- (a) What is mass parabola? (b) Graphically show the transitions of the following odd-A isobaric nuclei with parabolic presentation:
 $^{77}_{32}\text{Ge} \xrightarrow{\beta^-} ^{77}_{33}\text{As} \xrightarrow{\beta^-} ^{77}_{34}\text{Se}$ (Stable) and $^{77}_{36}\text{Kr} \xrightarrow{\beta^+} ^{77}_{35}\text{Br} \xrightarrow{\beta^+} ^{77}_{34}\text{Se}$
(c) Draw the binding energy per nucleon versus mass number curve. How does the curve explain fusion and fission? (d) What is nuclear isomerism? (2+2+4+2)

Internal Assesment-05