

**Sessional Exam-2021**

**B.Sc. 6<sup>th</sup> Sem**

**Paper: M601 Spectroscopy**

**Total Marks: 30**

**Time: 2hrs**

1. A particular molecule is considered to undergo spectroscopic transition between the ground state and the excited state. If the lifetime in the excited state is about 0.1 s, calculate the width of the spectral line in Hz. 2
2. If the pure rotational spectra of  $^{14}\text{NO}$  and  $^{15}\text{NO}$ , the first lines appear at  $3.4\text{ cm}^{-1}$  and  $3.2815\text{ cm}^{-1}$  respectively. If the atomic masses of  $^{14}\text{N}$  and O are 14.004 amu and 15.9994 amu respectively, find the atomic mass of  $^{15}\text{N}$ . 5
3. For HCl molecule, it shows a very intense absorption at  $2886\text{ cm}^{-1}$ , a weaker absorption around  $5668\text{ cm}^{-1}$  and a very weak one at  $8347\text{ cm}^{-1}$ . Calculate the equilibrium frequency and anharmonicity constant. 5
4. Calculate the moment of inertia of a  $\text{H}_2\text{O}$  molecule around its two-fold axis. The HOH bond angle is  $104.5^\circ$  and the bond length is 95.7 p.m. 5
5. Discuss the normal modes of vibration of  $\text{H}_2\text{O}$  and  $\text{CO}_2$  molecules with appropriate diagrams. 5
6. The infrared spectrum of CO shows a vibrational absorption peak at  $2170\text{ cm}^{-1}$ . What is the force constant of the CO bond? 3
7. Discuss the effect of isotopic substitution of in rotational spectroscopy with respect to  $^{12}\text{C}^{16}\text{O}$  and  $^{13}\text{C}^{16}\text{O}$  molecules. Draw and discuss Morse curve for a typical diatomic molecule. What is Morse function? 5