Reg.No. \_\_\_\_\_\_\_\_\_\_\_\_

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**End Semester Examination – Nov/Dec – 2018**

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| **Code :** | **17PH3008** | **Duration :** | **3hrs** |
| **Sub. Name :** | **ATOMIC AND MOLECULAR SPECTROSCOPY** | **Max. marks :** | **100** |

**ANSWER ALL QUESTIONS (5 x 20 = 100 Marks)**

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| **Q. No.** | **Sub Div.** | **Questions** | **Course**  **Outcome** | **Marks** |
| 1. | a. | Define total electronic angular momentum. | CO1 | 5 |
| b. | Discuss the different series of transitions arising out during the electronic transition in case of a hydrogen atom. | CO1 | 15 |
| (OR) | | | | |
| 2. | a. | List the Quantum numbers in case of an atom and a molecule. | CO1 | 5 |
| b. | With a neat energy level diagram discuss the fine structure of hydrogen atom. | CO1 | 15 |
| 3. | a. | A molecule does not rotate in its ground state. Justify. | CO2 | 5 |
|  | b. | Find the differences between the energy levels and discuss the spectrum of rigid diatomic rotator. | CO2 | 15 |
| (OR) | | | | |
| 4. | a. | Define Isotope. | CO2 | 5 |
|  | b. | If a particular atom in a molecule is replaced by its isotope, how does it affects the relative population of atoms and hence the energy levels in case of rotational spectroscopy. | CO2 | 15 |
| 5. | a. | Give the total number of degrees of freedom in case of a monoatomic gas. | CO3 | 5 |
|  | b. | Based on the symmetry of the molecules H2O and CO2, discuss the fundamental vibrations with a neat sketch. | CO3 | 15 |
| (OR) | | | | |
| 6. | a. | Imagine the HCl molecule as a spring. By fixing the position of chlorine atom, apply Hookes law and draw the energy diagram. | CO3 | 5 |
|  | b. | Support the concept of Zero point energy by treating hydrogen chloride as a simple harmonic oscillator. | CO3 | 15 |
| 7. | a. | Natural line width is unavoidable in any type of spectroscopy. Comment on this statement. | CO4 | 5 |
|  | b. | Determine the factors that affect the width and intensity of spectral transitions. | CO4 | 15 |
| (OR) | | | | |
| 8. | a. | Define the rule of mutual exclusion. | CO5 | 5 |
|  | b. | Using the selection rule ΔJ = 0 or ±2 only, find the spectral lines in case of pure rotational Raman Spectra of linear molecules. | CO5 | 15 |
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|  | | **Compulsory**: |  |  |
| 9. | a. | Sketch the Vibrational coarse structure of the band formed during electronic absorption from the ground (v”=0) state to a higher state. | CO6 | 5 |
|  | b. | Discuss the operation of the Franck Condon principle for  (a) internuclear distances equal in the upper and lower states.  (b) upper state internuclear distance a little less than that in the lower state (c) upper state distance a little greater than in the lower. | CO6 | 15 |