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**PG CBCS**  
**M.Sc. Semester-III Examination, 2020**  
**PHYSICS**  
**PAPER: PHS 302**

**Full Marks: 40****Time: 2 Hours****Write the answer for each unit in separate sheet**

The figures in the right-hand margin indicate full marks.  
 Candidates are required to give their answers in their own words as far as practicable

**302.1: Molecular Spectroscopy & LASER Physics****Marks: 20****Answer any two questions of the following:****10×2=20**

1. Compare the characteristics of vibrational spectra assuming a diatomic molecule as i. Harmonic and ii. Anharmonic oscillator. What is Hot Band? Spectrum of HCl shows very intense absorption at  $2886\text{ cm}^{-1}$  and a weaker absorption at  $5668\text{ cm}^{-1}$ . Calculate the equilibrium frequency. 6+1+3
2. Assuming molecule as a vibrating rotator and considering the interaction between them find the expression for wave numbers of two Branches? Explain what information we get from vibration- rotation band of a given diatomic molecule. 7+3
3. Determine the rotation energy levels of a diatomic molecule assuming it as a classical rigid rotator. Show the rotational energy levels assuming quantum picture. How the rotational energy and rotational spectrum changes in going from rigid to nonrigid rotator. 4+2+4
4. What is meant by vibrational coarse structure? Why the intensity of vibrational-electronic spectra vary for different transitions? What is Fortrat Diagram? 3+5+2
5. Given that the spacing between the vibrational levels of a CO molecule is  $8.45 \times 10^{-2}\text{ eV}$ ., calculate the value of the force constant  $k$  of the bond in a CO molecule. Explain the effect of Isotope in rotational spectra. 5+5
6. Describe in details the rotational fine structure of electronic-vibration transitions. For CO  $\nu_{\text{spect}} = 2143.28 + 3.813m - 0.0175m^2\text{ cm}^{-1}$ . Find  $B_1$ ,  $B_0$  and  $B_e$ . 7+3

(Turn Over)

(2)

**302.2: Nuclear Physics-I****Marks: 20****Answer any two questions of the following:****10×2=20**

1. Explain different portions of the binding fraction versus mass number plot. Write the similarity between a nucleus and a liquid drop. Explain the volume energy term in Bethe-Weizsacker mass formula. 5+3+2
2. What do you mean by mass parabola? Explain the nature of mass parabola for odd A and even A nuclei. What do you mean by parity of a nucleus? What do you mean by mirror nuclei? Give some examples. 6+2+2
3. With schematic diagram explain the basic principle of double focusing mass spectrometer. Discuss the basic features of alpha decay process. 6+4
4. What do you mean by Q-value of nuclear reaction? Discuss how the neutrino hypothesis was introduced. Discuss the basic differences between neutrino and anti-neutrino. Give a brief description of Kurie plot. 2+3+2+3
5. Describe Fermi's theory of beta decay. What do you mean by allowed and forbidden beta transition? 7+3
6. Discuss about the selection rules in beta decay. What do you mean by recoil free gamma spectroscopy? Discuss the significance of Wu's experiment. 3+2+5

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