Seat No. _____

Time : $2\frac{1}{2}$ Hours / Total Marks : **70**

Instructions : (1) All questions are compulsory.

(2) All questions carry equal marks.

1 Answer the following questions : (any **seven** out of ten) **14**

(i) Explain: The spin angular momenta for even number of electrons are an even multiple of 1/2.

(ii) Obtain the total angular momentum of electrons, which are in the orbit $n = 1$ and $n = 2$.

(iii) What is normal longitudinal and normal transverse Zeeman Effect?

(iv) Write down the selection rules for orbital, spin and total angular quantum number.

(v) Why the moments of inertia of a molecule changes through isotopical substitution?

(vi) What are prolate and oblate symmetric tops?

(vii) What is meant by linear polyatomic molecule?

(viii) What is Morse curve? Explain with a suitable figure.

(ix) Whom do you call the IR region of electromagnetic spectrum? How it is subdivided? How each sub-division is useful?

(x) What are Nernst glower and Globar filament?

2　Write any **two** : 　　　　　　　　　　　　　　　　　　　**14**

    (a)　Discuss : The fine structure of hydrogen atom spectrum.

    (b)　Discuss three basic rules that determine "How electrons occupy orbitals in large atoms".

    (c)　Discuss the spectra of alkali atoms with an example of Na atom spectra.

3　Answer the following questions : (all are compulsory)　　　**14**

    (a)　Discuss the quantum numbers associated with vector atom model.

    (b)　What is Paschen-Back Effect? Show that in a strong magnetic field, a given line will be split up into three components with equidistant separation of $eh/4\pi m$.

OR

3　Answer the following questions : (all are compulsory)　　　**14**

    (a)　Explain the rotational spectra of rigid diatomic molecules depicting the energy levels and transitions.

    (b)　Explain the effect of isotopical substitution in rotational spectrum.

4　Write any **two** : 　　　　　　　　　　　　　　　　　　　**14**

    (a)　Discuss the Morse curve and the energy levels of a diatomic molecule.

    (b)　Explain the first order Stark Effect of a symmetric top molecule for the $J = 1, K = 1 \rightarrow J = 2, K = 1$ transition.

    (c)　Discuss asymmetric top molecules showing the energy correlation diagram for asymmetric rotor.

5　Write notes on any **two** : 　　　　　　　　　　　　　　　**14**

    (i)　Symmetric stretching, symmetric bending and asymmetric stretching in H_2O and CO_2 molecules.

    (ii)　IR spectrophotometer.

    (iii)　Vibrating diatomic molecule.

    (iv)　Intensity rules and interval rule.

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