

Roll No. ....

Total Pages : 03

**GSQ/M-20**

**1749**

PHYSICS

Paper XII, PH-602

Atomic and Molecular Spectroscopy

Time : Three Hours]

[Maximum Marks : 40

**Note :** Attempt *Five* questions in all including Q. No. **1** which is compulsory. Select *one* question from each Unit. Non-programmable calculator is allowed.

**Compulsory Question**

1. (i) Explain the variation of Rydberg constant due to finite mass. 2
- (ii) Derive an expression for spin magnetic moment of an electron. 2
- (iii) What is the difference between  $pp$  and  $p^2$  configuration in LS coupling ? 2
- (iv) Calculate the separation between successive Zeeman-levels for  $^2P_{3/2}$  term in weak magnetic field. 2

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### Unit I

2. (a) Deduce the expression for the series spectra of hydrogen—like atom, taking into account the finite mass of the nucleus. 4
- (b) Describe Frank-Hertz experiment and explain the graph obtained between the current and accelerating voltage. 4
3. Describe Sommerfeld theory of the Hydrogen atom. 8

### Unit II

4. Explain the fine structure of Hydrogen spectrum. 8
5. Calculate the spin orbit interaction energy for a single non-penetrating valance electron. 8

### Unit III

6. Derive an expression for interaction energy for  $jj$ -coupling. Obtain the terms arising from the  $sp$  electron configuration and draw the energy level diagram. 8
7. Explain helium atom spectrum and give the difference between ortho-helium and para-helium. 8

#### **Unit IV**

- 8.** What is Stark Effect ? Explain weak field Stark Effect in hydrogen atom. Also, give the difference between Zeeman Effect and Stark Effect. **8**
- 9.** Explain the rotational and vibrational energy levels of molecules. **8**