MANIPAL UNIVERSITY

Reg. No.										

Deemed- to -be -University under Section 3 of the UGC Act, 1956

DEPARTMENT OF SCIENCES, M.Sc. (PHYSICS)
III SEMESTER - END SEMESTER EXAMINATIONS, NOVEMBER 2017

SUBJECT: ATOMIC AND MOLECULAR PHYSICS [PHY-701]

(REVISED CREDIT SYSTEM)

Time: 3 Hours Date: 15.11.2017 MAX. MARKS: 50

Note: (i) **Answer Any FIVE full questions.**

1. (a) Explain Larmor precession and obtain an expression for Larmor precession.
   (b) How does natural line broadening contribute to the line width of spectra?
   (c) What is a triplet state. [5+3+2]
2. (a) Briefly explain general components of an absorption experiment.
   (b) Draw 5f to 3d subshell transitions for alkali metals showing allowed and forbidden transitions. Write selection rules for such transitions. [5+5]
3. (a) Obtain magnetic resonance condition for a nucleus kept in a magnetic field of strength B.
   (b) Using spectroscopic notations, mention three x-ray states for L discontinuity electron states.
   (c) Calculate the ratio of population of the two nuclear spin states for protons in a magnetic field of 4T. (Given: g_N= 5.585; μ_N=5.05x10^{-27} JT^{-1}). [4+2+4]
4. (a) Draw electron spin resonance (ESR) spectrum of hydrogen atom showing energy expression and allowed transitions.
   (b) Outline the effect of isotopic substitution on the rotational spectra of molecules.
   (c) The first line in the rotational spectrum of CO has a frequency of 3.8424 cm^{-1}.
   Calculate the rotational constant and hence C-O bond length in CO. Given: Reduced mass = 1.1385 x 10^{-23} g [4+2+4]

5. (a) Explain the effect of anharmonicity on the vibrational spectra of diatomic molecules.

   (b) Explain basic principle of photo electron spectroscopy.

   (c) The fundamental and first overtone transitions of CO are centered at 2143 cm^{-1} and 4260 cm^{-1} respectively. Calculate the equilibrium oscillation frequency and anharmonicity constant of the molecule. [4+2+4]

6. (a) Explain mutual exclusion principle with example.

   (b) Explain florescence and phosphorescence by showing numerous energy levels for each electronic state.

   (c) The first three rotational Raman lines of a linear triatomic molecule are at 4.86, 8.14 and 11.36 cm^{-1} form the exciting line. Estimate moment of inertia of the molecule.

   [3+3+4]