MANIPAL ACADEMY of HIGHER EDUCATION
(Deemed to be University under Section 3 of the UGC Act, 1956)

Reg. No.										

DEPARTMENT OF SCIENCES, III SEMESTER M.Sc. (Physics)
END SEMESTER EXAMINATIONS, DECEMBER 2018

ATOMIC AND MOLECULAR PHYSICS [PHY 5101]

(REVISED CREDIT SYSTEM-2017)

Time: 3 Hours MAX. MARKS: 50

Note: (i) Answer **ALL** questions

(ii) Draw diagrams, and write equations wherever necessary

1. (a) Explain the theory of normal Zeeman effect.
   (b) How does natural broadening contribute to the line width of spectra?
   (c) What is a singlet state? [5+3+2]

2. (a) Explain basic principle of laser emission in a four level laser system with an example.
   (b) Obtain an expression for spin lattice relaxation time during magnetic resonance.
   (c) What is Larmor frequency? [5+3+2]

3. (a) Assuming diatomic molecule as a rigid rotator, obtain an expression for rotational energy in wavenumber units.
   (b) Draw Morse curve showing vibrational levels of a diatomic molecule.
   (c) Rotational and centrifugal distortion constants of HCl molecule are 10.593 cm^{-1} and 5.3 x 10-4 cm^{-1} respectively. Estimate the vibrational frequency and force constant of the molecule. Given: reduced mass is 1.626 x 10^{-27} kg. [3+2+5]

4. (a) Explain quantum theory of Raman scattering qualitatively.
   (b) Draw the schematics of a Raman spectrometer.

(c) The first three rotational Raman lines of linear triatomic molecule are 4.86, 8.14 and 11.36 cm^{-1} from the exciting Raman line. Estimate the rotational constant B and the moment of inertia of the molecule. [3+2+5]

5. (a) With the help of Frank-Condon principle, explain intensity of vibrational electronic spectra.

   (b) Explain basic principle of photoelectron spectroscopy.

   (c) The rotational lines of a band system of electronic vibration spectra of CN is given by $\tilde{\upsilon} = (25798 + 3.85\ p + 0.068\ p^2)\ cm^{-1}$. Estimate the position of band head. [3+2+5]