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, NOVEMBER 2018

ATOMIC AND MOLECULAR PHYSICS [PHY 5101]

(REVISED CREDIT SYSTEM-2017)

Time: 3 Hours Date: 20.11.2018 MAX. MARKS: 50

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

(ii) Draw diagrams, and write equations wherever necessary

1. (a) How to compute the total angular momentum J of a many electron system using L-S coupling scheme.
   (b) How does Doppler broadening contribute to the line width of spectra?
   (c) What is a triplet state. [5+3+2]

2. (a) What are Einstein's coefficients with reference to the laser? Derive the relation between them.
   (b) Obtain resonance condition for a nucleus placed in a magnetic field.
   (c) Why ^{12}C does not show NMR spectrum. [5+3+2]

3. (a) What is isotope effect in rotational spectra? Explain.
   (b) What is the effect of anharmonicity on the vibrational spectra of diatomic molecules.
   (c) The fundamental and first overtone transitions of CO are centred at 2143.3cm^{-1} and 4260.0 cm^{-1}. Calculate the equilibrium oscillation frequency, the anharmonicity constant and force constant of the molecule. The reduced mass of CO molecule is 1.1385×10^{-26} kg. [3+2+5]

4. (a) Explain classical theory of Raman scattering.

   (b) How do you correlate Raman and IR active vibrations in a molecule.

   (c) The bond length of N_2 molecule is 1.097×10^{-10} m. What would be the positions of the first three rotational Raman lines of N_2? Given: $^{14}N = 23.25 \times 10^{-27}$ kg. [3+2+5]

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

   (b) Explain basic principle Mossbauer spectroscopy.

   (c) The values of $\tilde{\upsilon}_e$ and x_e for lower and upper states of CO are 2170.21 cm^{-1}, 0.0062 and 1515.61cm^{-1}, 0.0114 respectively. The (0,0) transitions is observed at 64746.55 cm^{-1}. Calculate the energy difference of the two electronic states.