Name: Enrolment No:	

UPES

End Semester Examination, May 2025

Programme Name: MSc Physics **Semester:** II
Course Name: Atomic, Molecular and Laser Physics **Time:** 3 hrs
Course Code: PHYS7034 **Max.** Marks: 100
No. of pages: 2

Instructions: As instructed in each section. Symbols have their usual meanings.

SECTION A

(Answer all the questions: 5 Qs × 4 M = 20 Marks)

S. No.		Marks	CO
Q 1	Outline the characteristics of He-Ne laser.	4	CO1
Q 2	Identify the molecules (HBr, N_2, C_6H_6, HF, CO, CCl_4, HCl, O_2) which are rotational active and which are not in a tabular form.	4	CO1
Q 3	Estimate Lande 'g' factor for the state, $2^2P_{3/2}$.	4	CO2
Q 4	First rotation Raman line is observed at 200 cm^{-1}. Calculate moment of inertia of diatomic molecule.	4	CO3
Q 5	A vibrational level transition is observed at 3350 cm^{-1} for HF molecule. Calculate the force constant k. Atomic weight of 'F' is 18.998 a.m.u.	4	CO4

SECTION B

(Answer all the questions: 4 Qs × 10 M = 40 Marks)

Q 6	Elaborate with diagram, how rigid rotator energy level is different from non-rigid rotator.	10	CO1
Q 7	Show that for a rotating diatomic molecule equilibrium bond length can be expressed as, $r = \sqrt{\frac{hJ(J+1)}{8\pi^2 c\bar{\nu}\,\mu}}$ where, symbols have their usual meanings.	10	CO2
Q 8	Calculate spectral purity of a 5500 Å laser with coherence time of 1 ns. [1 ns = 10^{-9} sec].	10	CO3

Q 9	Analyse with example (a) jj coupling. **OR** (b) Anomalous Zeeman effect.	10	CO4
	SECTION C (Answer all the questions: 2 Qs × 20 M = 40 Marks)		
Q 10	(a) Describe Paschen-Back effect. (b) Compute the relation between the Einstein co-efficients A and B in the form, $A_{21} = \frac{8\pi h\nu^3}{c^3} B_{21}$	10 10	CO2 CO2
Q 11	(a) Sketch construction of diode laser and illustrate its working. (b) Outline N.M.R. Atoms (^{1}H) are subjected to 100 MHz frequency for nuclear magnetic resonance to occur. What magnetic field is required for operation? **OR** (a) Calculate magnetic field required to observe Zeeman spectral shift ($\Delta\nu$) of 14 GHz. (b) Analyse, P, R and Q branches of vibrational-rotational spectra of diatomic molecule.	10 10 10 10	CO3 CO4 CO3 CO4