

Total Pages : 4

End Semester Examination of Semester-III, 2016

Subject : PHYSICS (PG)

Paper : PHSPG-302

Full Marks : 40

Time : 2 Hrs

The figures in the margin indicate the marks corresponding to the question

Candidates are requested to give their answers in their own word as far as practicable.

Illustrate the answers wherever necessary

Use separate Answer scripts for Group A and Group B

Group A (Marks 20)

Answer Question No. 1 and any one out of Question No. 2 and Question No. 3.

1. Answer any five questions : 2x5=10
- i) Discuss the effect of isotopic substitution on the rotational spectra of molecules.
 - ii) Draw the Morse Potential Curve and explain the different region of the curve.
 - iii) The force constant of HCl molecule is 4.8×10^5 dynes/cm. Find the energy required to increase the nuclear separation by 1 \AA .

- iv) In what way the electronic absorption spectra of diatomic molecules differ from the emission spectra?
- v) What do you mean by pumping in Laser? What is threshold Pump Power?
- vi) Write Born-Oppenheimer approximation in case of molecular vibration, rotational and electronic spectroscopy.
- vii) Why does a spherical symmetric molecule is microwave inactive? Give an example of such type of molecule.
- viii) What are the advantages of four level laser over three level laser?
2. a) What is degeneracy? Taking degeneracy into account find out the value of J for which the intensity of the line will be maximum. 4
- b) In the rotational transition for $J = 0$ to $J = 1$. The absorption lines occur at 1.153×10^{11} C/S in $C^{12}O^{16}$ and at 1.102×10^{11} C/S in C^nO^{16} . Find the mass number n of the carbon isotope.
Given Mass of $C^{12} = 12M_H$,
Mass of $O^{16} = 16M_H$. 4
- c) What is the effect of increasing vibrational quantum number to very high value? 2
3. a) Briefly discuss the intensity distribution in absorption band from frank Condon principle. 4
- b) What are hot bands? Why they are so called? 2+1
- c) What are the different types of losses is a Laser? How these losses can be minimised? 3

Group – B (Marks 20)

**Answer Question No. 1 and any one out of
Question No. 2 and Question No. 3.**

1. Answer any five questions: 2×5=10

- i) For a graded index fibre show that $n \cos\theta$ is an invariant, where θ is the angle made by a ray with a layer of the fibre having r.i.n.
 - ii) Compare Pockel effect and Kerr effect.
 - iii) Describe, with diagram, the method of generation of fifth harmonic by a non-linear medium.
 - iv) Is second harmonic generation possible in Centro symmetric crystals? Explain.
 - v) Distinguish between 'ternary number' and 'MMSD' number.
 - vi) Convert 20.75_{10} to MMSD.
 - vii) What is cladding and what is the necessity of cladding in an optical fibre?
 - viii) A step index fibre has a core of refractive index 1.50 and a cladding of refractive index 1.40 calculate the numerical aperture in water environment. (refractive index of water in 1.33).
- 2. a) With necessary diagram describe the process of Opto-mechanical Q-switching for getting pulsed laser.**
- b) Show that an optical fibre cannot support TEM mode of propagation.**

(4)

- c) An optical fibre has: diameter = $50 \mu\text{m}$, r.i. of the core = 1.6, relative r.i. difference = 2.0%, length = 1 m, operating wave length = $0.85 \mu\text{m}$. A ray of light is incident at an angle of 30° at the entrance end.

Find i) V of the fibre, ii) number of internal reflections suffered by the ray in travelling the fibre. 4+4+2

3. a) Derive phase matching condition for second harmonic generation in a non-linear medium.
- b) Construct an opto-electronic XOR gate and discuss the action of the spatial light modulator.
- c) Construct a tristate OR logic gate and show its truth table. 4+(2+1)+(2+1)
-