2016

M.Sc.

3rd Semester Examination

PHYSICS

PAPER—PHS-302

Full Marks : 40

Time : 2 Hours

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Illustrate the answers wherever necessary.

Use separate Answer-scripts for Group-A & Group-B

Group-A

[Marks : 20]

Answer *Q. No. 1* and any *one* from the rest.

1. Answer any *four* bits : $2\frac{1}{2} \times 4$

(a) A tiny glass sphere of mass 10^{-8} g and 0.02 mm diameter can be kept floating in mid-air supported only by a beam of laser light directed upward. What is the irradiance (intensity) necessary to do that ?

(b) Find the ratio of the rates of spontaneous and stimulated emissions at $T = 10^3$ K for visible radiation of frequency 5×10^{14} Hz and microwave frequency 10^9 Hz. Comment on the result.

(c) The first rotational line of $^{12}C\ ^{16}O$ is observed at 3.84235 cm^{-1} and that of $^{13}C\ ^{16}O$ at 3.67337 cm^{-1}. Calculate the atomic weight of ^{13}C, assuming the mass of ^{16}O and ^{12}C be 15.9949 and 12.0000 respectively.

(d) The average spacing between successive rotational lines of carbon monoxide molecule is 3.8626 cm^{-1}. Determine the transition which gives the most intense spectral line at temperature 300 K.

(e) The fundamental band for D ^{35}Cl is centered at 2011.00 cm^{-1}. Assume that the internuclear distance is constant at 1.288Å and and calculate the wave numbers of the first two lines of P branches of D ^{35}Cl.
(Atomic masses of $^{35}Cl = 58.06 \times 10^{-27}$ kg
and $^{2}D = 3.344 \times 10^{-27}$ kg)

(f) Rotational analysis of one band system is given by $\gamma = 24762 + 25m - 2.1m^2 cm^{-1}$. Deduce the position of band head.

2. Explain what is meant by Vibrational coarse structure. Find rotational fine structure of electronic-vibration transition and hence explain P branch, R branch and Q branch. 2+8

3. (a) How many revolution per second does a CO molecule make when J = 3 ? The CO bond length is 0.1131 nm and atomic masses of C and O are 19.92168×10^{-27} kg and 26.561×10^{-27} kg respectively.

(b) Explain how the short laser pulses are generated by electro optical Q-switching.

(c) What do you mean by Q-factor of a laser resonatar ? Derive the expression for Q-factor of a laser resonator.

3+3+(1+3)

Group-B

[Marks : 20]

Answer Q. No. *1* and any *one* from the rest.

1. Answer any *five* questions : 5×2

(a) What is the difference between sputtering and thermal deposition ?

(b) What do you mean by UHV ? What are the pumps associated with UHV system ?

(c) Why the catalyst is needed for one directional growth in VLS synthesis route ?

(d) What do you mean by probe microscopy ?

(e) What are the different posibilities that can be resulted from the interaction of electron beam with matter ?

(f) Which one among ^{13}C and ^{16}O is NMR active ? Why ?

(g) What should be the characteristic property of a material that can be used as reference material in DTA-TGA instrument ?

(h) Differentiate XRD and XPS.

2. (a) Make a comparision between SEM & TEM.

(b) A material shows emission peak at 630 nm when excited by 500 nm in PL experiment. What do you mean by this statement ?

(c) What is the significance of stoke line and Anti-stoke line in Raman spectrum ?

6+2+2

3. (a) Give a schematic idea of Molecular Beam Epitaxy process.

(b) Show the different dimensional materials can be produced by Sol-Gel technique.

(c) Differentiate PLD and ALD.

(d) What are the information you can get from EDX ?

3+3+2+2

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