# 2012

## PHYSICS

PAPER—PHS-302 (A & B)

*Full Marks* : 40

*Time* : 2 hours

*The figures in the right-hand margin indicate marks*

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

*Illustrate the answers wherever necessary*

**Use separate scripts for Gr-A and Gr-B**

PAPER—PHS-302 (A)

[ *Marks* : 20 ]

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

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

(*a*) Convert the following spectroscopic quantities as indicated :

$2000\ cm^{-1}$ to Gm
0·15 nm to Hz
500 nm to $cm^{-1}$
9 GHz to $cm^{-1}$

(*b*) If H (hydrogen) is substituted by D (deuterium) in HCl atom, can you find any change in inter-atomic separation and in microwave spectrum ? Justify your answer.

(*c*) Find the number of normal modes of vibrations in $CO_2$ and $H_2O$ molecules.

(*d*) Explain what is meant by progressions.

(*e*) Describe in detail the pure Rotational Raman spectra in a solid.

(*f*) What is Frank condon principle ? Write its advantage in molecular spectroscopy.

2. Obtain the equation of population inversion in a four level laser system. What is the advantage of four level laser system over three level laser system ? What is

the fundamental difference between the generation of radiation from a laser system and a Na-vapor lamp ? Derive Burzar's law for a laser system. $5 + 1 + 1 + 3$

3. What do you mean by dissociation energy of a diatomic molecule. Obtain the expression of the highest vibrational energy level of a diatomic molecule having anharmonic oscillation. Hence find out the expression of dissociation energy of the molecule. Observing the vibration spectra of a diatomic molecule, how can you conclude about the interatomic separation of the molecule, whether it is increased or decreased or remains same after its transition from a lower electronic vibrational level to an upper electronic vibrational level. $2+2\frac{1}{2}+2\frac{1}{2}+3$

## PAPER—PHS-302 (B)

[ *Marks* : 20 ]

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

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

(*a*) Why cladding is necessary in an optical fibre ?

(*b*) Discuss the role of an optical fibre as wave guide.

(*c*) What are tristate numbers ? Why these are necessary ?

(*d*) Discuss the characteristics of non-linear material.

(*e*) Why coherent light is necessary in holographic recording ?

(*f*) Explain volume hologram.

2. Write some characteristics of $V$-parameter. Show that the ray-path in a graded index fibre is sinusoidal. A multimode fibre has a core of r.i. 1·46 and diameter 60 μm. The relative r.i. difference is 2.0%. Its operating wavelength is 0·8 μm. Calculate (*i*) r.i. of cladding, (*ii*) $V$-number and (*iii*) total number of guided modes supported by the fibre. $2+4+(1\frac{1}{2}+1\frac{1}{2}+1)$

3. Convert $10{\cdot}75_{10}$ to MMSD. Describe how second harmonic could be generated by a non-linear material mentioning the necessary conditions. Obtain the basic holographic equations explaining the terms in the equations. Describe the operation of an optoelectronic XOR gate. $2+2+4+2$