PG/IIIS/PH-2102/10

M.Sc. 3rd Semester Examination, 2010

PHYSICS

PAPER—PH-2102 (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

PAPER—PH-2102 A

(*Spectroscopy and Laser Physics*)

[*Marks* : 20]

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

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

(*a*) Write down three different applications of laser. What is the fundamental difference between the generation of radiation from a 3-level laser and a Na-vapour lamp ?

(*b*) What is Q-switching in a laser ? Write the possible duration of laser pulse in electro-optic, optomechanical and passive Q-switching.

(*c*) Find out the condition for maximum population in a rotational level.

(*d*) What is Frank Condon principle ? Write its advantage in molecular spectroscopy.

(*e*) With respect to principal moments of inertia discuss linear molecule and spherical top molecule along with examples.

(*f*) How many vibrations can be seen from a N-atomic linear molecule ? What will be the number if it is a N-atomic non-linear molecule ?

2. What is a four level laser system ? Why this type of system is advantageous over other laser systems ? Obtain the equation of population inversion in a four level laser system. Derive an expression for Q factor of a laser resonator. $1 + 1 + 5 + 3$

3. Describe in details the rotational fine structure of electronic-vibrational transition. Draw the Fortran diagram. $8 + 2$

PAPER–PH-2102 B

(*Photonics*)

[*Marks* : 20]

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

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

   (*a*) What is holography ? Make a comparison between ordinary photography and a holography.

(*b*) What is cladding and what is the necessity of cladding in an optical fibre ?

(*c*) What is non-linear material ? Give three examples (not available in nature) NLO crystals synthesized in laboratory.

(*d*) Explain the superiority of optical logic gates over electronic logic gates and optoelectronic logic gates.

(*e*) What is basic holography equation ?

(*f*) Construct an optoelectronic half-adder circuit.

2. What are the advantages of optical fibre communication over traditional wire communication ? Show that the ray path in a graded-index optical fibre is Sinusoidal. What is *V*-parameter of an optical fibre and what is its physical significance ? 2 + 4 + (2 + 2)

3. How phase matching condition is achieved for second harmonic generation by using a non-linear material ? Construct a tri-state 'OR' logic gate and show its truth table. How re-construction of object is done from Hologram ? What are the advantages of tri-state logic system over binary system ? Write down four applications of NLO materials. $2 + (2 + 1) + 2 + 1 + 2$