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End Semester Examination of Semester–III, 2015
Subject : PHYSICS (PG)
Paper : PHS–302 (Theory)
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) What is the advantage of cooking food in microwave oven over Pressure cooker?

   ii) The number of lines in a band are given by $\gamma_r = 1000(2n-1)\ cm^{-1}$ and $\gamma_r = -1000(2n+1)\ cm^{-1}$ for n positive and n negative respectively. Calculate the moment of inertia of the spectrum emitting system.

   iii) Discuss Frank Condon Principle.

   iv) What is Fertrat diagram?

v) Convert the following spectroscopic quantities as indicated.

2000 cm^{-1} to lim,

0·15 nm to Hz,

500 nm to cm^{-1},

9 GHz to cm^{-1}

vi) Calculate the ratio of stimulated to spontaneous emission rates for the wavelength λ = 5893Å at 200^0C.

vii) The energy gap between two levels corresponds to wavelength λ = 5000Å. Find the ratio of population of the two states in thermal equilibrium at 300 K.

viii) Find out the condition for maximum population in a rotational level.

2. a) Rotational analysis of one bond system in given by $\gamma = 24762 + 25\,m - 2{\cdot}1\,m^2$ cm^{-1}

Deduce the position of the band head and degradation of the band. 5

b) Deduce an expression for wave number separation between band head and band origin for rotational fine structure of electronic vibrational transition. 5

3. a) Deduce the threshold condition for Laser emission. 4

b) Explain from Laser rate equation that it is not possible to obtain Laser from a two energy level system. 4

c) Discuss different types of optical resonator. 2

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: 2x5=10

   i) What is meant by Q-switching in laser radiation?

   ii) In a graded index fibre the radial distribution of refractive index is given by $n(r) = 1{\cdot}56 - 2r^2$ where r is in mm. upto a radius of 0·2 mm. Calculate the acceptance angle of the fibre.

   iii) What are the important requirements for Q-switching?

   iv) Subtract 50_{10} from 27_{10} by the principle for tristate number system. Convert the result to decimal system.

   v) What do you mean by non-linearity of a medium?

   vi) Discuss, why there is no antisymmetric TE type of electromagnetic wave is found in a planar waveguide.

   vii) What are the reasons behind pulse dispersion in step index optical fibre?

   viii) What is sum Frequency generation? Write a practical application of it.

2. a) Derive expression for intermodal broadening in a multimode optical fibre. 3

b) An optical fibre has the following characteristics – length = 1 km, n_{core} = 1·45, $n_{cladding}$ = 1·44. Can you send a pulse train having duty cycle $\frac{1}{2}$ and frequency 1 MHz through fibre? Why? 3

c) What is V-parameter of an optical fibre and what is its physical significance? 2+2

3. Draw the diagram of a tristate AND gate and describe its action.

Convert $50{\cdot}02_{10}$ to MMSD using basic principle of conversion.

Show that XOR and AND logic operations could be simultaneously obtained with light by using non-linear material only.

Show that a parallel beam of light passing through a non-linear material would be focussed at a smaller distance if the intensity of the beam be increased. 2+2+3+3