(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 0929   Roll No. ☐☐☐☐☐☐☐☐☐☐

B. Tech.

(SEMESTER–III) THEORY EXAMINATION, 2012-13

LASER SYSTEMS AND APPLICATIONS

Time : 3 Hours]   *[Total Marks : 100*

Section – A

1.   Attempt **all** question parts :   10 × 2 = 20

(a)   Show that population inversion is a condition of negative temperature.

(b)   Brief note on absorption and give the equation for the rate of absorption.

(c)   What do you mean by coefficient of gain ? Find the expression for it.

(d)   Write about Optical pumping and its schemes.

(e)   Mention the main components of LASER.

(f)   Specify the characteristics of LASER beam.

(g)   Why is a four level LASER more efficient than a three level LASER ?

(h)   List out the features of materials used for laser action.

(i)   Why a pulse laser is generally used for material processing ?

(j)   The near infrared laser is preferred for optical communication. Give the reason.

Section – B

2.   Attempt any **three** question parts :   10 × 3 = 30

(a)   Illustrate about the following :

(i)   Spatial coherence

(ii)   Temporal coherence

(b) Derive the time independent and time dependant Schrodinger equation for a non-relativistic particle.

(c) With a neat schematic diagram explain the principle of four level laser.

(d) Enlist the conditions in which a laser will work in cw/pulse mode. Show that a cw laser is suitable for time measurement.

(e) How communication gets facilitated using laser and fibre ? Estimate the number of telephone channels possible to have an optical fibre network using laser of wavelength 1.55 μm.

Section – C

Attempt **all** questions. $10 \times 5 = 50$

3. Attempt any **two** parts : $(5 \times 2 = 10)$

(a) Calculate the coherence length of a laser beam for which the bandwidth equal to 3000 Hz. The speed of light is 3×10^8 m/s.

(b) Obtain the relationship between the size of the source and the coherence of the field.

(c) Define Q-factor of an optical resonator. Show that $Q = v_0/\Delta v$, where v_0 – resonant frequency and Av - full width at half maximum.

4. Attempt any **one** part : $(10 \times 1 = 10)$

(a) Write the significance of Einstein's coefficients and explain the relation between Einstein's A and B coefficients.

(b) Explain spontaneous emission and stimulated emission of radiation. Obtain a relation between transition problems of spontaneous and stimulated emission.

5. Attempt any **one** part : $(10 \times 1 = 10)$

(a) Elaborate the generation and measurement of short laser pulses.

(b) Elucidate the construction and working of excimer laser.

6. Attempt any **one** part : (10 × 1 = 10)

   (a) Describe the working of He-Ne laser with a neat diagram. What are the characteristics of output laser beam from He-Ne laser ?

   (b) With necessary diagram, explain the construction and working of Nd-YAG laser.

7. Attempt any **two** parts : (5 × 2 = 10)

   (a) Mention few applications of laser in medicine and explain any one.

   (b) Narrate the process of hole drilling with laser.

   (c) Which are the lasers suitable for surgical operations and list out their merits and demerits ?

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0929   3