Sl. No.   :   **2149**   **GC-3**   **Your Roll No. ....**

Unique paper code   :   32223908

Name of the paper   :   SEC: Applied Optics

Name of the course   :   **B. Sc. (H) Physics / B. Sc. Prog**

Semester   :   III

Duration : 2 Hours   Max Marks:- 50

Attempt four questions in all. Question No. 1 is compulsory.

1.   Attempt any five of the following.   (5 x 4=20)

   a.   What is the difference between spontaneous and stimulated emission of radiation.

   b.   Explain the characteristics of laser light.

   c.   What do you understand by the spatial frequency? If one-dimensional field distribution of an object is represented by a function given below:

$$f(x) = cos(3.141x) + cos(6.283x) + cos(9.424x)$$

   Then find out the different spatial frequencies contained by the object.

   d.   What is the holography and how it is different from the photography?

   e.   What are the differences between multimode and single mode fibres?

   f.   Find out the numerical aperture and acceptance angle of an optical fibre, if the refractive indices for core and cladding are 1.6 and 1.5, respectively.

   g.   What is Fourier transform and how can it be performed optically?

   h.   A laser beam has wavelength of $7200A°$ and aperture$5 \times 10^{-3}m$. The laser beam is sent to moon at a distance $8 \times 10^8 m$ from the earth. Determine (a) angular spread and (b) areal spread when it reaches moon.

2.   a)   How the transmission type hologram is different from the reflection type hologram explain with diagram.   (7)

   b)   How is the holography used for character recognition?   (3)

3. a) What is the basic principle of optical fibres; discuss the propagation mechanism of light wave in optical fibre. (6)

b) A signal of power of 5 μW exists just inside the entrance of 0.1km long fibre. Calculate the absorption coefficient of the fibre if the power outside the fibre is 1μW. (4)

4 a) Why optical fibres are so important? Write the different advantages of optical fibre over traditional metal communication lines (5)

b) Discuss the physical significance of acceptance angle. How does it depend on refractive indices of core and cladding? (5)

5. a) Discuss the main components of the laser. How population inversion is achieved in practice? (5)

b) A three-level laser emits a light of wavelength of 5500Å. What will be the ratio of population of upper level (E_2) to the lower energy level (E_1) if the optical pumping mechanism is shut off (Assume T=300K). At what temperature for the above condition the ratio of population will be ½?,K=1.38 × 10^{-23} m^2 kg s^{-2} K^{-1} (5)

6. a) What is the principle of laser? Explain the working of He-Ne laser with the help of diagram. (6)

b) Calculate the power per unit area delivered by a laser pulse of energy 4.0 × $10^{-3}J$ and the pulse length in time as $10^{-9}s$. When the pulse is focused on target to a very small spot of radius 1.5 × $10^{-5}m$. (4)

7. a) How to construct a spatial frequency filtering system opticallyandhow the desired spatial frequencies can be filtered out by using thissystem? (7)

b) Draw the diagrams of different apertures which work as low pass, high pass and band pass filters. (3)