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63/1 (SEM-4) SEC2/PHYSE4022

2025

**PHYSICS**

Paper : PHYSE4022

**(Applied Optics Skill)**

Full Marks : 50

Pass Marks : 20

Time : Two hours

**The figures in the margin indicate full marks for the questions.**

1. Choose the correct answer : **(any five)**  
1×5=5
- (a) The relation for attenuation of light in a transparent medium is
- (i)  $I=I_0 e^{-\alpha x}$
- (ii)  $I=I_0 e^{\alpha x}$

(iii)  $I = I_0 e^{-\frac{1}{2}\alpha x}$

(iv)  $I = I_0 e^{\frac{1}{2}\alpha x}$

(b) The probability that a spontaneous transition occurs

(i) Independent on the properties of energy states

(ii) Depends on photon density

(iii) Depends on properties of energy states and independent of the photon density

(iv) None of the above

(c) The Ruby laser uses

(i) Single level pumping scheme

(ii) Two level pumping scheme

(iii) Three level pumping scheme

(iv) Four level pumping scheme

(d) An interference filter in an optical system transmit

(i) Narrow range of wavelengths

(ii) Wide range of wavelengths

(iii) Very wide range of wavelengths

(iv) Very narrow range of wavelengths

(e) Holography is based on -

(i) The interference of reference and object waves which are coherent

(ii) Recording of superposed images of two different wave lengths

(iii) Recording the phase information of the resultant for the reference and the object

(iv) Super position of object and the reference waves which are of slightly different wave lengths

(f) Which is used to divide LASER beam into two parts in making a hologram-

(i) Beam choser

(ii) Beam splitter

(iii) Collimator

(iv) All of the above

(g) The propagation of light in an optical fibre from one of its ends to the other end is based on the principle of

- (i) Polarization of light
- (ii) Photo-electronic effect
- (iii) Total internal reflection
- (iv) Diffraction of light

(h) The condition for the total internal reflection at the optical fibre is -

- (i) The refractive index of the core material must be slightly greater than that of the cladding
- (ii) The refraction index of the core material is equal to that of the cladding
- (iii) The refractive index of the core material is smaller than that of the cladding
- (iv) The refractive index of the core material is very bigger than that of the cladding

(i) The life of electron in metastable state is -

(i)  $10^{-9} S$

(ii)  $10^{-3} S$

(iii)  $10^{-8} S$

(iv)  $10^{-8} S$

(j) The image produced by hologram is-

(i) One dimensional

(ii) Two dimensional

(iii) Three dimensional

(iv) Four dimensional

2. Answer the following questions : **(any five)**  
 $2 \times 5 = 10$

(a) Write *two* characteristics of stimulated emission

(b) Draw the energy level diagram of Ruby-laser.

(c) Write *two* properties of a hologram.

(d) What are the conditions of total internal reflection.

- (e) Draw the diagram of a single optical fibre cable.
- (f) Write the working principle of LED.
- (g) Write the principle of Nuclear Magnetic Resonance (NMR) spectroscopy.

3. Answer the following questions : **(any five)**  
5×5=25

- (a) Write the construction and working of Helium-Neon (He-Ne) LASER.
- (b) Explain the reconstruction of the image of the Hologram.
- (c) Explain Rayleigh scattering in intrinsic attenuation in optical fibre.
- (d) What is the principle of Fourier transform spectroscopy? Explain the uses of FTIR spectroscopy. 3+2=5
- (e) Explain the propagation of light through an optical fibre.
- (f) What are Einstein coefficients? Derive an expression between them. 1+4=5
- (g) A fibre cable has an acceptance angle of 30° and core index of refraction of 1.4. Calculate the refractive index of the cladding.

4. Answer the following questions : **(any one)**  
1×10=10

- (a) What are critically angle and acceptance angles of a fibre? Find the expression for the acceptance angle of a fibre. 4+6=10
- (b) Explain *four* important characteristics of a LASER beam. 2½×4=10
- (c) Write short notes on : **(any two)**  
2×5=10
  - (i) Multiplex hologram
  - (ii) Photo-detectors
  - (iii) Fibre Bragg grating
  - (iv) Michelson interferometer