E 8555 (Pages : 4) Reg. No.....

Name.....

B.Sc. DEGREE (C.B.C.S.S.) EXAMINATION, OCTOBER 2014

Fifth Semester

Core Course—PHYSICAL OPTICS AND PHOTONICS

(Common for Model I and Model II B.Sc. Physics, B.Sc. Physics-EEM and B.Sc. Physics-Instrumentations)

Time : Three Hours Maximum Weight : 25

Part A

Answer **all** *questions.*
Objective type questions-weight 1 for each bunch.

BUNCH I

1. Laser light is considered to be coherent because it consists of :
   (a) Many wavelengths. (b) Uncoordinated wavelengths.
   (c) Coordinated wavelengths. (d) Divergent waves.
2. In a two beam interference pattern, the maximum and minimum intensity values are found to be $25I_0$ and $9I_0$ respectively, where I_0 is a constant. The intensities of the two interfering beams are :
   (a) $16I_0$ and I_0. (b) $5I_0$ and $3I_0$.
   (c) $17I_0$ and $8I_0$. (d) $8I_0$ and $2I_0$.
3. The order of pumping power necessary to achieve the population inversion in a ruby laser is :
   (a) 10^7 W/m^2. (b) 10^2 W/m^2.
   (c) 10^{10}W/m^2. (d) 10^{16}W/m^2.
4. The numerical aperture of an optical fiber cable with a core of refractive index n_1 and cladding of refractive index n_2 is :
   (a) $\sqrt{n_1^2 - n_2^2}$ (b) $\sqrt{n_1^2 + n_2^2}$
   (c) $\sqrt{n_1 - n_2}$ (d) $\sqrt{n_1 + n_2}$

BUNCH II

Choose the correct answer :

5. In Newton's rings experiment, the diameter of the 10th ring changes from 1.5cm to 1cm when a drop of liquid is introduced between the lens and the glass plate. Then the refractive index of the liquid is :
   (a) 2.25. (b) 1.5.
   (c) 12.15. (d) 1.33.

Turn over

6. When the atoms in the source go from an excited state (E_2) to a lower energy state (E_1), spontaneous emission of radiation takes place. Then the energy of the emitted photon will be :

   (a) $h\upsilon_{12}, = E_2 - E_1$. (b) $h\upsilon_{12} = E_2/E_1$.

   (c) $h\upsilon_{12} = E_1/E_2$ (d) $h\upsilon_{12} = 0$.

7. When a ray of light enters a glass plate from air :

   (a) Its wavelength decreases.

   (b) Its wavelength increases.

   (c) Its frequency increases.

   (d) Neither its wavelength nor its frequency changes.

8. In Michelson Interferometer 200 fringes cross the field of view when the movable mirror is moved through lmm. Then the wavelength of the light used is :

   (a) 10^{-8}m. (b) 10^{-7}m.

   (c) 10^{-6}m (d) 10^{-5}m.

BUNCH III

'ill in the blanks :

9. When a beam of unpolarized light falls on a glass, the reflected beam contains more vibrations ———— to the plane of incidence.

10. The wave front of ordinary ray is ————.

11. When a wave is reflected from an optically denser medium it suffers a phase change of ————

12. Polarization of light proves ———— nature of matter.

BUNCH IV

'ill in the blanks :

13. In interference there is a distribution of ————.

14. Colours in a thin film results from ————.

15. MASER stands for ————.

16. The mathematical form of Brewster's law is ————.

(4 × 1 = 4)

Part B

Answer any **five** *questions.*
Short answer questions-weight 1 *each.*

17. Why do thin transparent films appear brilliantly coloured when viewed in sun light ?
18. Distinguish between interference bands and diffraction bands.
19. How did Fresnel explain rotatory polarization ?
20. What are quarter wave plates ? What are its uses ?
21. Explain the working of a single mode fiber.
22. Distinguish between positive and negative crystals.
23. Give an account of three level laser systems.
24. What are the advantages of optical fibers ?

$(5 \times 1 = 5)$

Part C

Answer any **four** *questions.*
Short Essay/Problems-Weight 2 *each.*

25. A parallel beam of wavelength 580 nm is incident on a thin glass plate of refractive index 1.5 such that the angle of refraction is 60°. Calculate the smallest thickness of the plate which will appear dark on reflection.
26. Two coherent sources of intensity ratio β interfere. Prove that in the interference pattern

$$\frac{I_{max} - I_{min}}{I_{max} + I_{min}} = \frac{2\sqrt{\beta}}{1+\beta}.$$

27. Numerical aperture of an optical fiber is 0.2, which is single mode at wavelength 1.0 micron. Find the maximum value of the radius of the fiber.
28. A quartz crystal has thickness 0.1436 mm and refractive indices $n_o = 1.5443$ and $n_e = 1.5533$. For what wavelengths in the visible region will it act as
    (i) A quarter wave plate ?
    (ii) A half wave plate ?
29. Find the radii of the first three transparent zones of a zone plate behaving like a convex lens of focal length lm for light of wavelength 589.3 nm.

30. A laser is operating in threshold condition. Calculate

    (i) Loss factor

    (ii) Loss coefficient

    Given reflection coefficients of the mirrors are 0.999, length of the laser medium is 50cm and active medium gain is 1.02.

(4 × 2 = 8)

Part D

Answer any **two** *questions.*
Essay-Weight 4 *each.*

31. Explain how Newton's rings are formed. Derive an expression for the radius of the n^{th} ring. Describe an experiment to determine the refractive index of a liquid by Newton's rings arrangement.

32. Explain the principle and working of semiconductor laser.

33. Discuss the Fraunhoffer diffraction pattern at a double slit. Explain how certain orders of spectra will be missing in the double slit diffraction pattern.

(2 × 4 = 8)