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Reg. No.....

Name.....

B.Sc. DEGREE (C.B.C.S.S.) EXAMINATION, OCTOBER 2023

Fourth Semester

Complementary Course—PHYSICAL OPTICS, LASER PHYSICS AND SUPER CONDUCTIVITY

[For the Programmes B.Sc. Chemistry Model I, B.Sc. Chemistry Environment and Water Management and B.Sc. Geology]

(Prior to 2013 Admissions)

Time : Three Hours Maximum Weight : 25

Candidates can use Clark's table and scientific non-programmable calculators.

Part A (Objective Type)

Answer **all** *questions. This contain four bunches of objective questions.*
Choose the most appropriate alternative.
Weight 1 *each.*

BUNCH I

1. For constructive superposition the phase difference between two waves should be :

   (a) $4n\ \pi$. (b) $3n\ \pi$.

   (c) $2n\ \pi$. (d) π.

2. The population inversion in a medium is possible with :

   (a) Cooling. (b) Magnetizing.

   (c) Pumping. (d) None of these.

3. The phenomenon of forced photon emission by an excited atom due to the action of an external agency is called :

   (a) Induced emission. (b) Simulated emission.

   (c) Spontaneous emission. (d) None of these.

Turn over

4. Of the following which produces o-ray and e-ray ?

(a) Uniaxial crystal. (b) Biaxial crystal.

(c) Isotropic crystal. (d) Anisotropic crystal.

BUNCH II

5. In Fresnel experiment the phase difference between two waves from successive half period is :

(a) $\pi/2$. (b) $\pi/4$.

(c) π. (d) 0.

6. In diffraction phenomena all the maxima are of :

(a) Constant intensity. (b) Zero intensity.

(c) Same intensity. (d) Different intensity.

7. Ordinary light is :

(a) Linearly polarized. (b) Circularly polarized.

(c) Elliptically polarized. (d) Unpolarised.

8. The mathematical form of Brewster's law is:

(a) $\mu = \tan_p$. (b) $\mu = \sin \Theta_p$.

(c) $\mu = \cos \Theta_p$. (d) $\mu = \tan i$.

BUNCH III

9. The ability of an optical instrument to produce distinctly separate images of two objects located very close to each other is its :

(a) Dispersive power. (b) Resolving power.

(c) Both (a) and (b). (d) None of these.

10. The phase difference introduced by a quarter wave plate between e-ray and o-ray is :

(a) 90°. (b) 180°.

(c) 270°. (d) 360°.

11. When a magnetic material is super cooled it becomes :

(a) Ferromagnetic. (b) Diamagnetic.

(c) Paramagnetic. (d) None of these.

12. In the formation of Newton's rings in reflected system, the central spot is :

(a) Dark. (b) Bright.

(c) Uniformly illuminated. (d) None of these.

BUNCH IV

13. Colours in soap bubbles can be explained using :

(a) Refraction. (b) Diffraction.

(c) Interference. (d) None of these.

14. Ratio of intensities between a point A and that of central fringe is 0.853. Then path difference between two waves at point A will be :

(a) $\lambda/2$. (b) $\lambda/4$.

(c) $\lambda/3$. (d) $\lambda/8$.

15. Which among the following laser is more efficient ?

(a) Ruby laser. (b) He-Ne laser.

(c) YAG laser. (d) Cannot predict.

16. Double refraction is associated with :

(a) Interference. (b) Diffraction.

(c) Polarization. (d) Refraction.

$(4 \times 1 = 4)$

Part B (Short Answer Type Questions)

Answer any **five** *questions.*
Each question carries a weight of 1.

17. Differentiate between interference by division of wave front and by division of amplitude.

18. State and explain superposition principle.

19. State and explain Malu's law.

Turn over

20. Distinguish between Quarter wave plate and Half wave plate.

21. Distinguish between uniaxial and biaxial crystals with examples.

22. Discuss two applications of Laser.

23. What are Einstein co-efficients ?

24. Can we produce population inversion in a two level system ? Justify your answer.

(5 × 1 = 5)

Part C (Short Essay/Problems)

Answer any **four** *questions.*
Each question carries a weight of 2.

25. In Young's double slit experiment, the angular width of a fringe formed on a screen is 0.1°. The wavelength of light used is 6000°A. What is the spacing between the slits ?

26. In Newton's rings experiment, diameter of the 4^{th} and 12^{th} dark rings are 0.4 cm and 0.7 cm respectively. Deduce the diameter of the 12^{th} dark ring.

27. Determine the polarizing angle on the surface of water. Refractive index of water air interface is 1.35.

28. A grating has a total of 15000 lines on it. Find its resolving power at a wavelength 500 nm in the first order and second order.

29. Discuss stimulated emission.

30. Explain BCS theory.

(4 × 2 = 8)

Part D (Essay Type Questions)

Answer any **two** *questions.*
Each question carries a weight of 4.

31. With a neat diagram, explain the formation of Newton's rings. How can you determine the wavelength of light ?

32. With necessary theory, explain the detection and production of circularly and elliptically polarized light.

33. Explain the principles, construction and working of a YAG Laser.

(2 × 4 = 8)