Reg. No…….. Name…… **21U431-S**

B. Sc. DEGREE END SEMESTER EXAMINATION JULY - 2021

SEMESTER **– 4: PHYSICS (COMPLEMENTARY FOR CHEMISTRY)**

COURSE: **15U4CPPHY8: PHYSICAL OPTICS, LASER PHYSICS AND SUPERCONDUCTIVITY**

(Common for Improvement 2018 admission / Supplementary 2018/2017/2016/2015/2014 admissions)

Time: Three Hours Max. Marks: 60

PART A

Answer ***all*** questions. Each question carries ***1*** mark

1. State the principle of superposition.
2. Write down the conditions for having constructive interference and destructive interference explaining the letters used in the condition.
3. Define polarisation of light waves? Which property of light waves does the phenomenon of polarisation reveal?
4. What do you mean by double refraction? Give an example for a doubly refracting crystal.
5. Write down the significance of population inversion in lasing action?
6. List four functions of optical resonator of a laser device?
7. Define superconductivity. Give an example.
8. What do you mean by Cooper pairs? What is their significance in modern physics?

(1 × 8 = 8)

PART B

Answer ***any six*** questions. Each question carries ***2*** marks

9. Differentiate between Fresnel and Fraunhofer diffraction by mentioning four aspects.
10. Define diffraction of light. What is the use of a diffraction grating?
11. Explain how plane polarised light can be produced by selective absorption, with an example.
12. Differentiate between positive and negative crystals with examples for each.
13. Briefly explain how population inversion is established in Ruby laser?
14. Obtain the relation between the Einstein's coefficients in lasing action.
15. Write a short note on high temperature superconductors with an example.
16. Some insulators act as superconductors. Substantiate. (2 × 6 = 12)

PART C

Answer ***any four*** questions. Each question carries ***4*** marks

17. In Young's double slit experiment, the separation of the slits is 1.9 mm and fringe spacing is 0.31mm at a distance of 1 meter from the slits. Calculate the wavelength of light.
18. Calculate the least width of a plane diffraction grating having 500 lines/cm, which will just resolve in the second order, the sodium lines of wavelengths 5890 A^o and 5896 A^o.
19. Calculate the thickness of a doubly refracting crystal required to introduce a path difference of $\lambda/2$ between the ordinary ray and extraordinary ray when λ = 6000 A^o, m_o=1.5442, μ_ε = 1.5533.
20. How will you orient the polarizer and the analyser so that a beam of natural light is reduced to (i) 0.5 (ii) 0.25 (iii) 0.75 (iv) 0.125.

21. What fraction of sodium atom is in the first excited state in a sodium vapour lamp at a temperature of 250^{o}C.Given wavelength of sodium line is 5900 A^{o}.
22. For a given superconductor, the critical fields are respectively, 1.4 x 10^5 and 4.2 x 10^5 ampere/metre for 14K and 13K. Calculate the transition temperature and critical fields at 0K and 4.2 K. (4 × 4 = 16)

PART D

Answer ***any two*** questions. Each question carries ***12*** marks

23. Discuss the formation of interference fringes on a screen due to the monochromatic light passing through two parallel slits. Also arrive at the expression for fringe width.
24. With the help of neat diagrams, explain the construction and working of a He-Ne laser.
25. Explain the mechanism of conduction in superconductivity, with an account on Cooper pairs and BCS theory. Mention two applications of superconductivity.
26. What do you mean by quarter wave plate? Explain its construction and use. How can it be used to produce and detect beams of elliptically and circularly polarized light?

(12 × 2 = 24)

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