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P – 3858

Reg. No. :

Name :

Third Semester B.Sc. Degree Examination, January 2023

First Degree Programme under CBCSS

Physics

Complementary Course for Chemistry and Polymer Chemistry

PY 1331.2 : OPTICS, MAGNETISM AND ELECTRICITY

(2019 Admission Onwards)

Time : 3 Hours

Max. Marks : 80

SECTION – A

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

1. Define self-inductance of a coil. Write its S.I. unit.
2. State Lenz's law.
3. What happens to intensity, if amplitude is doubled?
4. If crest of a wave superposes on crest of another wave, what happens to resultant displacement?
5. What are transverse electromagnetic waves?
6. Give any use of diffraction grating.
7. Draw the magnetic field lines of a current carrying solenoid.
8. Define magnetisation (M).

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9. What are hard ferromagnets?
10. What is the condition for population inversion?

(10 × 1 = 10 Marks)

SECTION – B

Answer any **eight** questions. Each carries **2** marks.

11. Why is it necessary to have coherent sources in order to produce an interference pattern?
12. If two coherent sources of amplitude A and B, with phase difference ϕ superpose at a point P, then resultant amplitude and intensity at P will be?
13. What you mean by diffraction?
14. Differentiate between Fresnel and Fraunhofer diffraction.
15. Draw and explain magnetic hysteresis loop for ferromagnetic materials.
16. State Faraday's law of electromagnetic induction.
17. Using a neat diagram, represent unpolarised and plane polarised lights.
18. What you mean by resonant frequency?
19. Define Quality factor (Q).
20. What happens when a capacitor (initially charged) is connected to an inductor?
21. How transformers work?
22. What are the advantages of fiber optic cables over copper?
23. What you mean by attenuation?
24. Explain spontaneous emission.
25. Give Brewster's law.
26. Differentiate between step index and graded index fiber.

(8 × 2 = 16 Marks)

SECTION – C

Answer any **six** questions. Each carries **4** marks.

27. For a certain material the refractive index is 1.648. Find the angle of polarisation and angle of refraction.
28. Laser light of wavelength 640 nm incident on a pair of slits produces an interference pattern in which the bright fringes are separated by 7.2 mm. Calculate the wavelength of another source of light which produces interference fringes separated by 8.1 mm using same arrangement.
29. A small compass needle of magnetic moment 'm' is free to turn about an axis perpendicular to the direction of uniform magnetic field 'B'. The moment of inertia of the needle about the axis is 'I'. The needle is slightly disturbed from its stable position and then released. Prove that it executes simple harmonic motion. Hence deduce the expression for its time period.
30. The instantaneous current and voltage of an ac. circuit are given by $i = 10 \sin 300 t$ A and $V = 200 \sin 300 t$ V. What is the power dissipation in the circuit?
31. Calculate the minimum thickness of a soap bubble film of refractive index 1.33, that result in constructive interference in the reflected light, if the film is illuminated with light whose wavelength in free space is 600 nm.
32. In a single slit diffraction experiment first minimum for $\lambda_1 = 660$ nm coincide with first maxima for wavelength λ_2 . Calculate λ_2 .
33. A domain in ferromagnetic iron is in the form of a cube of side length $1 \mu\text{m}$. Estimate the number of iron atoms in the domain and the maximum possible dipole moment and magnetisation of the domain. The molecular mass of iron is 55 g/mole and its density is 7.9 g/cm^3 . Assume that each iron atom has a dipole moment of $9.27 \times 10^{-24} \text{ Am}^2$.
34. A pure inductor of 25.0 mH is connected to a source of 220 V. Find the inductive reactance and rms current in the circuit if the frequency of the source is 50 Hz.

35. A resistor of 200Ω and a capacitor of $15.0 \mu\text{F}$ are connected in series to a 220 V , 50 Hz ac source. (a) Calculate the current in the circuit; (b) Calculate the voltage (rms) across the resistor and the capacitor. Is the algebraic sum of these voltages more than the source voltage? If yes, resolve the paradox.
36. Prove that the reflected and the refracted beams are at right angles to each other.
37. (a) The critical angle of light in certain substance is 45° . What is its polarising angle?
- (b) Calculate thickness of $\frac{\lambda}{4}$ plate for light of wavelength 5894 \AA . Given $n_o = 1.544$ and $n_e = 1.553$.
38. A laser beam of wavelength 6000 \AA , power 10 mW and angular spread 1.5×10^{-4} radian is focused by a lens of focal Length 10 cm .
- (a) Find radius and power density of image
- (b) Find the coherence width.

(6 × 4 = 24 Marks)

SECTION – D

Answer any **two** questions. Each question carries **15** marks.

39. Give a note on Nicol prism. How can you use Nicol prism as polariser and as analyser?
40. Consider a wedge-shaped thin film. Deduce the conditions for maxima and minima for the interference in transmitted light.
41. What is Fresnel diffraction? Explain Fresnel diffraction at a straight edge.
42. Differentiate between Paramagnetism. Diamagnetism. Ferromagnetism and anti ferromagnetism.
43. Using Phasor diagram, solve for ac voltage applied to series LCR circuit
44. With a neat diagram explain the principle of operation of LASER? Also give a note on applications of LASER.

(2 × 15 = 30 Marks)