

(Two papers due to re-exam) 16/06/2012 original paper
(2 hours)

GN 1042

[Total marks : 75]

- N.B. (i) Question no. 1 is compulsory.
(ii) Attempt any four questions from Q.nos. 2 to 7.
(iii) Figures to the right indicate full marks.
(iv) Use suitable data wherever necessary.

1. Attempt any five from the following: 15
- (a) Explain the effect on Newton's rings pattern when oil of refractive index ($\mu=1.65$) is introduced between the lens ($\mu=1.5$) and the glass plate ($\mu=1.75$).
- (b) A grating has 620 rulings/mm and is 5.05mm wide. What is the smallest wavelength interval that can be resolved in the third order at $\lambda=481\text{nm}$?
- (c) Explain the terms: Stimulated emission and Population inversion.
- (d) Calculate the de Broglie wavelength of an electron whose kinetic energy is 120eV. [$m_e = 9.1 \times 10^{-31} \text{ kg}$, $h = 6.63 \times 10^{-34} \text{ J-s}$].
- (e) Distinguish between paramagnetic and ferromagnetic materials.
- (f) Differentiate between step-index and graded-index fibre.
- (g) A magnetic material has magnetization of 2300A/m and produces a flux density of 0.00314 Wb/m^2 . Calculate magnetizing force H and relative permeability of the material.
2. (a) Derive the conditions for a constant thickness film to appear bright and dark when being viewed in reflected light. 8
- (b) Describe the construction and working of He-Ne laser with schematic and energy-level diagrams. 7
3. (a) What are anti-reflecting films? In costume jewelry, rhinestones (made of glass with $\mu = 1.5$) are often coated with silicon monoxide ($\mu = 2.0$) to make them more reflective. How thick should the coating be to achieve strong reflections for 560nm light, incident normally? 8
- (b) What is holography? Explain the construction and reconstruction of a hologram. 7
4. (a) Develop one-dimensional time-dependent Schrodinger equation for matter waves. 8
- (b) Discuss Weiss's theory of ferromagnetism and derive Curie-Weiss's law. 7

5. (a) What is an optical resonator cavity? What role does it play in producing laser beam? 5
- (b) A mild steel ring having a cross-sectional area of 5cm^2 and mean diameter 20cm has a coil of 200 turns wound on it. Calculate the reluctance R and the current required to produce flux of 1mWb ($\mu_r = 380$) neglecting air gap. 5
- (c) An electron moves in the x-direction with a speed of 1.88×10^6 m/s. If this speed is measured to a precision of 1%, with what precision can you simultaneously measure its position? 5
6. (a) Explain the working principle of a pirani gauge. 5
- (b) Describe the working of a scanning electron microscope (SEM) with diagram. 5
- (c) What are hard and soft magnetic materials? Write their characteristic properties and applications. 5
7. (a) What is meant by numerical aperture of an optical fibre? An optical fibre has a numerical aperture of 0.20. Determine the acceptance angle for the fibre in water ($\mu = 1.33$). 5
- (b) A monochromatic light from He-Ne laser $\lambda = 6328\text{\AA}$ is incident normally on a diffraction grating having 6000 lines/cm. Find angles at which first and second order maxima would be observed. 5
- (c) Newton's rings are observed in reflected light of wavelength 5×10^{-5} cm. The diameter of 10th dark ring is 0.5cm. Calculate radius of curvature R and thickness of film t at the ring. 5

- N.B. :** 1. Q 1 is compulsory
 2. Attempt any four questions from Q 2 to Q 7.
 3. Figures to the right indicate full marks.
 4. Assume suitable data if necessary.

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| 1. | Attempt any five from the following: | 15 |
| | a) Differentiate between spontaneous emission and stimulated emission processes related to laser operation. | |
| | b) Explain how the number of lines ruled per centimeter on plane transmission grating decides the maximum number of orders of diffraction? | |
| | c) Why a ray of light takes a zigzag path in a step index fiber and sinusoidal path in a graded index fiber? | |
| | d) A wedge shaped air film is illuminated by light of wavelength 4650 \AA . The angle of wedge is $40''$. calculate fringe separation between two consecutive fringes. | |
| | e) What do you mean by "phase velocity" and "group velocity" related to matter waves? | |
| | f) Find relative permeability of a ferromagnetic material if the field strength of 220 amp/m produces a magnetization of 3300 amp/m . | |
| | g) what is the role of resonant cavity in the operation of a LASER? | |
| 2. | a) Describe in detail the concept of antireflection coating along with a proper ray diagram of thin film interference. Which conditions the material should satisfy to act as antireflection coating? | 8 |
| | b) A plain transmission grating has 15000 lines/inch . Find the angle of separation for 5048 \AA and 5016 \AA lines of Helium in second order spectrum? | 7 |
| 3. | a) Explain in detail the construction and working of ND-YAG laser with proper construction and energy level diagrams. | 8 |
| | b) Explain why Newton's rings are unequally spaced? If Newton's rings are formed using light of wavelength 5896 \AA in reflected light with a liquid placed between plane and curved surfaces. The diameter of 7^{th} bright fringe is 0.4 cm and radius of curvature is 1 meter . Find refractive Index of liquid. | 7 |
| 4. | a) Discuss atomic origin of magnetization. What is Bhor magneton and it's significance? | 8 |
| | b) The position and momentum of 1 Kev electron are simultaneously measured. If the position is located within 1 \AA what is the percentage of uncertainty in momentum? ($M_e = 9.1 \times 10^{-31} \text{ kg}$, $e = 1.6 \times 10^{-19} \text{ C}$) | 7 |
| 5. | a) What is Uncertainty Principle? Explain how the concept of wave particle duality and single slit diffraction of electron can be used to prove the Uncertainty Principle ? | 8 |
| | b) Write difference between LED and LASER diode. Discuss in short the application of laser in the field of communication. | 7 |
| 6. | a) Discuss the working of an Atomic Force Microscope with the help of a schematic diagram. | 8 |
| | b) Consider a multimode step index fiber with core index $= 1.53$ and cladding index $= 1.50$. If core radius is 50 \mu m , calculate Numerical aperture, V number and number of modes transmitted through fiber using a wavelength of 1 \mu m . | 7 |
| 7. | a) What are three main ranges of vacuum on the basis of pressure. With the help of an appropriate diagram, explain the working of a thermocouple gauge. | 8 |
| | b) An iron ring of mean circumferential length 30 cm and cross sectional area 1 cm^2 is wound uniformly with 300 turns. When current $I = 0.032 \text{ amp}$ flows through winding and flux in the ring is $2 \times 10^{-6} \text{ wb}$. Find flux density, applied magnetic field strength and permeability of iron. | 7 |