



- Notes :
1. All questions carry marks as indicated.
  2. Solve Question 1 OR Questions No. 2.
  3. Solve Question 3 OR Questions No. 4.
  4. Solve Question 5 OR Questions No. 6.
  5. Solve Question 7 OR Questions No. 8.
  6. Due credit will be given to neatness and adequate dimensions.
  7. Assume suitable data whenever necessary.
  8. Illustrate your answers whenever necessary with the help of neat sketches.
  9. Use of non programmable calculator is permitted.

List of constants:-

- 1) Velocity of light  $c = 3 \times 10^8$  m/sec
- 2) Charge of electron  $e = 1.602 \times 10^{-19}$  C
- 3) Mass of electron  $m = 9.11 \times 10^{-31}$  kg
- 4) Mass of Proton  $m_p = 1.67 \times 10^{-27}$  kg.

1. a) Describe with the energy level diagram, the construction and working of He-Ne Laser. 4
  - b) Define the terms: 3
    - i) Metastable state
    - ii) Temporal coherence
    - iii) Stimulated emission.
  - c) Find the relative populations of the two states in a ruby laser that produce the light beam of wavelength  $6943 \text{ \AA}$  at 300K. 3
- OR**
2. a) Draw a neat diagram of experimental set up for the Newton's rings formation. Why are the rings circular? Why the rings are not evenly spaced? 2+1  
+1
  - b) What is antireflection coating? Obtain the condition for minimum thickness of such a coating. 1+2
  - c) When a wedge shaped air film is viewed by a monochromatic source of light incident normally, the interference fringes  $0.4\text{mm}$  apart are observed. If the air space is filled with water ( $\mu=1.33$ ) how far apart will the fringes be observed? 3
3. a) Show that an electron moves along a parabolic path when it enters uniform electric field applied perpendicular to its motion. 4
  - b) Derive an expression for the radius and time period for an electron in a transverse magnetic field. 3
  - c) A proton accelerates from rest in a uniform electric field of  $500 \text{ N/C}$ . At some time later, its speed is  $2.5 \times 10^6 \text{ m/sec}$ . 3
    - i) Find the acceleration of the proton.
    - ii) Time taken by the proton to reach the above velocity?
    - iii) What is its k.r. at this time?

**OR**

4. a) Explain how a charged particle describes a helical path in a uniform magnetic field. Obtain the expression for the pitch, radius and time period of the helix. **4**
- b) What is crossed field configuration? Explain . Determine the velocity of the charged particle without any deviation? **3.**
- c) An electron shot into a uniform magnetic field at an angle  $60^\circ$  moves in a spiral of radius 10cm and with a period of  $6 \times 10^{-5}$  sec. Determine the magnetic induction and electron velocity. **3**
5. a) Explain Bethe's law of electron refraction. **3**
- b) Draw the schematic of an electrostatic CRT. Write the function of  
i) Electron gun and. ii) Aquadag coating. **2+2**
- c) What are Lissajous patterns? Define synchronization. How the intensity of the trace on the screen is controlled? **1+1**  
**+1**

**OR**

6. a) What is cyclotron? State the resonance condition. What are primary functions of electric and magnetic fields. **1+1**  
**+2**
- b) Explain construction and working of Bainbridge mass Spectrograph. **3**
- c) Protons are accelerated in a cyclotron. The magnetic field strength is  $1.3 \text{ Wb/m}^2$  and the radius of the last semicircle is 0.5m. **3**  
i) What must be frequency of the oscillator supplying power to the dees?  
ii) What is the final energy acquired by the proton beam?
7. a) Draw structure of optical fibre and write function of each part. **1+2**
- b) Derive an expression for numerical aperture of a step index fibre in terms of  $\Delta$  . **2**
- c) Define the terms: **1+1**  
i) Attenuation and dispersion. ii) Modes of propagation in optical fibre.
- d) Calculate the angle of acceptance and fractional refractive index for a given optical fibre if the refractive indices of the core and the cladding are 1.563 and 1.498 respectively. **3**

**OR**

8. a) What are nanomaterials? Write the reasons for change in properties of materials at nanoscale. **1+2**
- b) Describe the following methods for synthesis of nanomaterials in brief? **2+2**  
i) Ball milling ii) Sol-gel process.
- c) Write short note on Zeolites. **3**

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