**Paper / Subject Code: FE1903 / Physics**

**FE1903**

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**F.E Semester-I (Revised Course 2019-20)**
**EXAMINATION OCTOBER 2020**
**Physics**

**[Duration : Two Hours]** **[Total Marks : 60]**

**Instructions:**
1) Answer THREE FULL QUESTIONS with ONE QUESTION FROM EACH PART.
2) **Assume** additional data, if required.
3) **Draw** diagrams **wherever** required.

**Physical constants:**

| | |
|---|---|
| Planck's constant | = $6.626 \times 10^{-34}$ J-s |
| Electron charge | = $1.6 \times 10^{-19}$ C |
| Boltzmann's constant | = $1.38 \times 10^{-23}$ J/K |
| Electron mass | = $9.1 \times 10^{-31}$ kg |
| Rydberg constant | = $1.097 \times 10^{7}$ /m |
| Velocity of light | = $3 \times 10^{8}$ m/s |

## PART A

Q.1 a) Explain interference in wedge shaped film and derive expression for fringe width. Draw necessary diagrams. (5)

b) Briefly explain the types of magnetic materials. Give three examples of each. (5)

c) A piezoelectric crystal of thickness 2.8 mm produces USW of frequency 410 KHz. Calculate the thickness of this crystal to produce ultrasonic waves of frequency 550 KHz. (5)

d) Briefly explain physical origin of Hall Effect. Derive an expression for Hall voltage in terms of current through the semiconductor material. (5)

Q.2 a) Draw block diagram of CRO and explain its various sections. (5)

b) Calculate intrinsic carrier density of a silicon sample with resistivity $6.3 \times 10^{4} \Omega$m at 300 K. Given –mobility of electron = 0.14 $m^2$ / V-s and hole mobility = 0.05 $m^2$/v-s. (5)

c) With the help of a neat diagram, explain how the Newton's rings setup can be used to determine refractive index of a liquid. (5)

d) Describe acoustic diffraction method to find velocity of ultrasonic waves in liquid. (5)

Q.3 a) Explain hysteresis loop. What is retentivity and coercivity? (5)

b) With a neat circuit diagram explain working of Piezoelectric Oscillator for production of Ultrasonic waves. (5)

c) In Newton's ring's experiment, the diameter of $5^{th}$ and $15^{th}$ dark rings were measured as 0.7 cm and 0.85 cm respectively. What is the wavelength of light if the radius of curvature of the plano-convex lens is 95 cm? (5)

d) What is energy gap? With the help of energy band structure explain three types of solids. (5)

## PART B

Q.4 a) Describe construction and working of Ruby laser with necessary diagrams. (5)

b) A glass clad fiber is made with core of R.I. 1.5 and cladding is doped to give fractional index difference 0.005. Find : i) R.I. cladding ii) Critical Angle iii) Numerical aperture iv) Acceptance angle. (5)

c) What is Compton Effect? Derive an expression for Compton shift. (10)

Q.5 a) He –Ne laser is emitting a laser beam with an average power of 4.5 mw. Find the number of photons emitted per second by the laser. $\lambda = 6328\ A^o$. (5)

b) What are the types of optical fibers? Discuss each one of them separately. Draw the necessary diagrams. (5)

c) Write down any four properties of X-rays. Also mention Physical significance of Mosley's law. (5)

d) Describe Davisson-Germer experiment to prove wave-like character of a beam of electron. (5)

Q.6 a) Calculate the de Broglie wavelength of (5)

i) A cricket ball of mass 0.5 kg moving with a speed of 25 m/s.

ii) An electron in motion having energy 20 Kev.

b) Describe optical resonator. What role does it play in laser? (5)

c) What is X-ray diffraction? With neat diagram explain the working of Bragg's spectrometer. (5)

d) Explain the origin of continuous X-rays and derive expression for cut-off wavelength in continuous x-rays. (5)

## PART C

Q.7 a) Explain Briefly the role of ultrasonic waves in: (5)
   i) Flaw detection in metals
   ii) Echo sounding in marine application.

b) Fringes of equal thickness are observed in a thin glass wedge of refractive index 1.52 when viewed with light of wavelength 5893 A. Calculate the wedge angle if the fringe spacing is 0.1 mm. (5)

c) Explain the term "Numerical Aperture". Hence, derive an expression for numerical aperture of optical fiber in terms of i) refractive indices of core and cladding material ii) fractional R.I. differences. (5)

d) Briefly describe advantages of laser over conventional source of light. (5)

Q.8 a) Give at least two differences between the following: (5)
   i) Spontaneous emission and stimulated emission
   ii) Step-index fibre and graded index fibre
   iii) He-Ne laser and Ruby laser

b) The ratio of population of two energy levels out of which upper one corresponds to a metastable to a metastable state is $1.059 \times 10^{-30}$. Determine the wavelength of light emitted at 330K. (5)

c) Show that the diameter of Dark rings in Newton's Rings for reflected light is proportional to the square root of natural numbers. (5)

d) What are soft and hard magnetic materials? Give their properties and applications. (5)