FE102

Total No. of Printed Pages:2

F.E. (Sem – I/II) (Revised Course 2016-17)
EXAMINATION NOV/DEC 2019
Applied Science (Physics)

[Duration : Three Hours] **[Total Marks : 100]**

Instructions:

1) Answer **any two** questions from Part-A and Part-B **each** and **any one** question from Part-C.
2) **Assume** additional data, if required.
3) **Draw** diagrams **wherever** required.

Physical constants:

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

Part – A

Answer **any two** questions:

1.
a) Derive an expression for conductivity of a semiconductor in terms of mobility of charge carriers. **(5)**
b) Explain interference in wedge shaped film and hence derive expression for fringe width. Draw necessary diagrams. **(5)**
c) Briefly explain the types of magnetic materials. Give 3 examples of each. **(5)**
d) Calculate the velocity of ultrasonic waves in a liquid used in an acoustic diffraction experiment using the following data: **(5)**
Wavelength of light used = 5893 Å
Frequency of ultrasonic transducer=100 MHz
Angle of diffraction for 2^{nd} order maxima $=4°30'$

2.
a) With neat ray diagram explain how the Newton's Rings setup can be used to determine the radius of curvature of a plano-convex lens. **(5)**
b) Explain any three methods of detection of ultrasonic waves. **(5)**
c) With neat diagram explain working of electrostatic lens. **(5)**
d) Calculate the concentration of donor atoms to produce n-type material with conductivity of 5 $\Omega^{-1}\text{m}^{-1}$and electron mobility of $0.35\text{m}^2/\text{V. s}$.What will be the diffusion constant of the above material at 27°C. **(5)**

3.
a) Derive the Continuity Equation for p-type semiconductor. **(5)**
b) Draw a neat block diagram of CRO. Explain the function of trigger circuit. **(5)**
c) With neat circuit diagram explain working of piezoelectric oscillator for production of ultrasonic waves. **(5)**

d) A parallel beam of monochromatic light of wavelength 5890 AU is incident on a thin glass plate of R.I. 1.33 such that the angle of refraction into the plate is 60°. Calculate the smallest thickness of the glass plate which would appear dark by reflection. (5)

Part – B

Answer **any two** questions:

4. a) Explain the process of stimulated emission of radiation and how it can be used for light amplification. (5)
   b) What is superconductivity? Discuss in brief BCS theory of superconductivity. (5)
   c) Explain the industrial, medical and scientific uses of x-rays. (5)
   d) Calculate numerical apperture, acceptance angle, and critical angle for an optical fibre having core R.I. 1.52 and cladding R.I. 1.48. (5)

5. a) Derive expression for acceptance angle of an optical fibres. What is acceptance cone of optical fibre? (5)
   b) What is x-ray diffraction? Derive Bragg's Law of x-ray diffraction. (5)
   c) What is Compton effect? Describe the experimental setup to study Compton effect. (5)
   d) The mode separation of a 5 mW He-Ne laser operating at 6328 Å is 1500 MHz. What must be the length of the laser cavity to ensure that only one longitudinal mode oscillates. How many photons will be emitted from the laser in one second? (5)

6. a) With neat diagrams explain step-index and graded-index optical fibres. (5)
   b) With neat diagrams explain type-I and type-II superconductors. (5)
   c) With neat energy diagram explain 3-level pumping scheme. What are its drawbacks? (5)
   d) Calculate the de Broglie's wavelength of (5)
      i) a cricket ball of mass 0.5 kg moving with a speed of 25 m/s
      ii) an electron having energy 20 KeV

Part – C

Answer **any one** question:

7. a) Show that the diameter of bright rings in Newton's Rings using reflected light is proportional to the square root of odd natural numbers. (5)
   b) Write the industrial, electronics, medical, military and scientific uses of laser. (5)
   c) What is Hall Effect? Give an explanation of Hall effect of p-type and n-type semiconductor. (5)
   d) Identity the target element used in the Coolidge tube if the wavelength of the K_α line emitted in 1.55 Å. Take nuclear screening constant as unity. (5)

8. a) Explain the following applications of ultrasonic waves: (5)
      (i) SONAR
      (ii) Ultrasound scanning
   b) Draw a neat block diagram of a CRO. Explain the need of saw-tooth signal at the horizontal deflection plates. (5)
   c) Explain ferromagnetism. Write four properties of ferromagnetic materials. (5)
   d) Calculate the critical current (I_c) for 1mm diameter loop of lead at 4°K. Given T_c for lead = 7.18°K and H_0 for lead = 6.5×10^4 A/m. (5)

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