SEM 1 – 2A (RC 16 – 17)

F.E. (Semester – I) (Revised in 2016 – 17)
Examination, November/December 2017
APPLIED SCIENCE (Physics)

Duration : 3 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	=	6.626×10^{-34} J-s
Electron charge	=	1.6×10^{-19} C
Boltzmann's constant	=	1.38×10^{-23} J/K
Electron mass	=	9.1×10^{-31} Kg
Rydberg constant	=	1.097×10^{7}/m
Velocity of light	=	3×10^{8} 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) With the help of a neat ray diagram obtain the condition for interference maxima and minima due to transmitted light from a parallel thin film. **5**

   c) Briefly explain the types of magnetic materials. Give 3 examples of each. **5**

   d) What is magnetostriction ? Calculate the natural frequency of an iron rod of length 10 cm and comment on whether it can be used to generate USW using magnetostriction oscillator. Given, density of iron = 7.8×10^{3} kg/m^3, Young's modulus of iron = 11.5×10^{10} N/m^2. **5**

P.T.O.

2. a) With neat ray diagram explain how the Newton's Rings setup can be used to determine wavelength of monochromatic source of light. 5

   b) Explain hysteresis loop. What is retentivity and coercivity ? 5

   c) With neat diagram explain working of electrostatic lens. 5

   d) A n-type semiconductor of width 1 cm and having concentration of electrons as $2.5 \times 10^{21}/m^3$ is used in a Hall effect experiment having magnetic field of 0.7 T. Calculate the Hall voltage if a current of 0.5 A flows through the semiconductor. Also calculate the Hall coefficient of the semiconductor. 5

3. a) Derive the continuity equation for n-type semiconductor. 5

   b) Explain how to find the voltage and frequency of an a.c. signal using CRO. 5

   c) With neat circuit diagram explain working of piezoelectric oscillator for production of ultrasonic waves. 5

   d) A wedge-shaped air film is illuminated with monochromatic light of wavelength 6000 AU and fringes having a spacing of 0.5 mm are observed. Calculate the angle of the wedge. If the air film is replaced with a liquid film of refractive index 1.33 what will be the fringe spacing. 5

PART – B

Answer **any two** questions.

4. a) With neat energy diagram explain 3-level pumping scheme. What are its drawbacks ? 5

   b) What is superconductivity ? Discuss in brief BCS theory of superconductivity. 5

   c) Draw a neat diagram of Coolidge tube and explain the production of X-rays using Coolidge tube. 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 fibre. What is acceptance cone of optical fibre ? 5

   b) Draw a neat diagram of Bragg's spectrometer and explain how it is used to determine the interplanner distance in a cystalline solid. 5

c) What is Compton effect ? Describe the experimental setup to study Compton effect. 5

d) What is population inversion ? Determine the ratio of population of two energy levels out of which one corresponds to a metastable state if the wavelength of light emitted at 47°C is 6943 AU. 5

6. a) With block diagram explain the use of optical fibres in communication. Give any two advantages of optical fibres over copper wires for communication. 5

b) Explain briefly Meissner effect and Silsbee effect in superconductors. 5

c) With neat diagrams explain construction and working of Ruby laser. 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 in motion having energy 20 KeV.

PART – C

Answer **any one** question.

7. a) Show that the diameter of bright rings in Newton's Rings using transmitted light is proportional to the square root of natural numbers. 5

b) Explain the differences between conventional and laser source of light. 5

c) What is Hall Effect ? Explain the applications of Hall Effect. 5

d) Identify the target element used in the Coolidge tube if the wavelength of the $K\alpha$ line emitted is 1.55 AU. Take nuclear screening constant as unity. 5

8. a) Explain the following applications of ultrasonic waves : 5

i) Detection of flaws in metals

ii) Echo-sounding.

b) Draw a neat block diagram of a CRO. What is the purpose of the trigger circuit in the CRO ? 5

c) What are soft and hard ferromagnetic materials ? Write their properties and Applications. 5

d) Calculate the critical current (I_c) for a 1 mm 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
