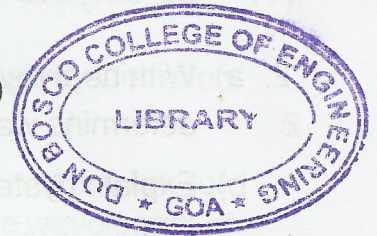




# SEM 1 – 2A (RC 16 – 17)

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 :

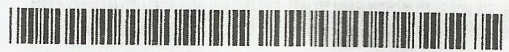
Planck's constant	=	$6.626 \times 10^{-34}$ J-s
Electron charge	=	$1.6 \times 10^{-19}$ C
Boltzmann's constant	=	$1.38 \times 10^{-23}$ J/K
Electron mass	=	$9.1 \times 10^{-31}$ Kg
Rydberg constant	=	$1.097 \times 10^7/m$
Velocity of light	=	$3 \times 10^8$ m/s

### PART – A

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 =  $7.8 \times 10^3$  kg/m<sup>3</sup>, Young's modulus of iron =  $11.5 \times 10^{10}$  N/m<sup>2</sup>. 5

P.T.O.

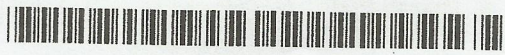


2. a) With neat ray diagram explain how the Newton's Rings setup can be used to determine wavelength of monochromatic source of light. 5
- b) Explain hysteresis loop. What is retentivity and coercivity? 5
- c) With neat diagram explain working of electrostatic lens. 5
- d) A n-type semiconductor of width 1 cm and having concentration of electrons as  $2.5 \times 10^{21}/\text{m}^3$  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 aperture, 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 interplanar distance in a crystalline 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 =  $6.5 \times 10^4$  A/m. 5