# F.E. (Semester – I) (RC 2016-17) Examination, Nov./Dec. 2016
## APPLIED SCIENCE (Physics) (New)

Duration : 3 Hours  Max. 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) Briefly discuss the physical origin of Hall effect. Derive an expression for Hall voltage interms of current through the semiconductor. **5**
   b) Explain hysteresis in soft and hard magnetic materials and give an account of their specific applications. **5**
   c) Obtain an expression for fringe width in a wedge shape film interms of angle of wedge and wavelength of light used. **5**
   d) The wavelength of light transmitted through a liquid is 5800 A°. The first order angle of diffraction is 0.046°. Calculate velocity of ultrasonic waves in liquid if the frequency of ultrasonic waves produced by transducer is 2 MHz. **5**

2. a) With the help of an experimental set up, explain the Newton's ring method to determine refractive index of a liquid. **5**
   b) Describe acoustic diffraction method to find velocity of ultrasonic waves in liquid. **5**
   c) Explain construction and working of magnetic lens. **5**
   d) Calculate the resistance of a block of silicon at 300 K and of length 0.5 cm and cross section $3 \times 10^{-7}$ $m^2$, doped with $4 \times 10^{22}$ phosphorus atoms/$m^3$. What current flows when 1 V is applied along its length ? Given diffusion constant of electron is 0.0036 $m^2$/s. **5**

3. a) Draw block diagram of CRO and briefly explain its application to determine amplitude of dc voltage. 5

   b) Write down atleast three features in each of the following materials (i) diamagnetic (ii) paramagnetic and (iii) ferromagnetic material. 5

   c) Newton's ring set up is used with a source emitting two wavelengths $\lambda_1 = 6000$ A° and $\lambda_2 = 4500$A°. It is found that the $n^{th}$ dark ring due to 6000 A° coincides with $(n+1)^{th}$ dark ring due to 4500 A°. If radius of curvature of lens is 90 cm, find the diameter of $n^{th}$ dark ring for 6000 A°. 5

   d) Derive the conditions of bright and dark interference fringes due to transmitted light from a parallel sided thin film. 5

## PART – B

Answer **any two** questions.

4. a) Explain the origin of continuous X-ray spectrum. Obtain expression for cutoff wavelength in the spectrum. 5

   b) Write down the characteristic properties of laser. Identify the property of laser which will be useful in welding, surveying and fiber optics communication. 5

   c) Briefly explain BCS theory of superconductivity. 5

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

5. a) Explain the terms :
      i) Silsbee effect
      ii) Meissner effect. 5

   b) What is basic principle of fiber optics ? Explain the classification of optical fibers based on mode of propagation. 5

   c) Describe construction and working of ruby laser. Draw the necessary diagrams. 5

   d) A photon of energy 1.02 MeV is scattered through 90° by a free electron. Calculate the energy of photon and electron after recoil. 5

6. a) Describe Bragg's X-ray spectrometer to verify Bragg's law. 5

   b) Explain the term acceptance angle of optical fiber. Obtain an expression for numerical aperture of an optical fiber interms of refractive indices of core and cladding material. 5

   c) What is optical resonator ? What role does it play in laser ? 5

   d) What voltage must be applied to an electron source to produce electron having de Broglie wavelength of 0.4 A° ? What will be kinetic energy of the electron moving under this potential ? 5

## PART – C

Answer **any one** question.

7. a) What is meant by direct and inverse piezoelectric effect ? Give an account of echo sounding in marine application. 5

   b) Explain the importance of an extended source of light while observing interference in thin films. 5

   c) Calculate the critical current ( $I_c$) for 1 mm diameter wire of lead at 5 K from the following data. 5

   $T_c$ for lead = 7.18 K and $H_0$ for lead = $6.5 \times 10^4 \frac{A}{m}$.

   d) How does stimulated emission take place with exchange of energy between helium and neon atoms in a He-Ne laser ? Mention industrial applications of laser (any two). 5

8. a) What are coercivity and retentivity ? Give any two differences between diamagnetic and ferromagnetic material. 5

   b) How does drift and diffusion currents arise in a semiconductor ? Briefly explain use of Hall effect in identifying the type of semiconductor. 5

   c) A laser system emits photons of wavelengths 6925 A° and 6941 A° due to transition at ground state from the upper and lower energy states. Calculate the energy values of these energy levels in eV and also their ratio of populations. 5

   d) Write down any four properties of X-rays. Also mention physical significance of Mosley's law. 5

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