



SEM 1-2 (RC 07-08)

F.E. (Sem. – I) (RC 07-08) Examination, Nov./Dec. 2012 APPLIED SCIENCE – I

Duration : 3 Hours

Total Marks : 100

SECTION – I

(Physics)

Module – I

1. a) Prove that in reflected light, radii of bright circular Newtons rings are proportional to square roots of odd natural numbers. 5
- b) A sample of intrinsic germanium has a carrier concentration of $2.5 \times 10^{19}/\text{m}^3$. It is doped with antimony at a rate of one antimony atom per million atoms of germanium. If concentration of germanium atoms is $4.8 \times 10^{28}/\text{m}^3$. Find hole concentration and conductivity of semiconductor. Assume complete ionisation of antimony atoms. 5
- c) Derive Einstein's relation between diffusion constant D and mobility μ of charge carriers. If mobility of electron is $0.36 \text{ m}^2\text{V}^{-1}\text{S}^{-1}$ at 300 K, what is its diffusion constant. Given, $K = 1.38 \times 10^{-23} \text{ J/K}$ and $e = 1.6 \times 10^{-19} \text{ C}$. 5
- d) Explain briefly :
 - i) Phase change at reflection
 - ii) Meaning of optical path and geometric path
 - iii) Application of interference in checking flatness a plane surface and in checking perfect curvature of a lens. 10
2. a) Explain briefly the generation and recombination of charge carriers in semiconductor. Derive the expression for the recombination of excess minority carriers within a semiconductor. 5
- b) A Newton's rings arrangement is used with a source emitting two wavelengths, $\lambda_1 = 6 \times 10^{-5} \text{ cm}$ and $\lambda_2 = 4.5 \times 10^{-5} \text{ cm}$ and it is found that the n^{th} dark ring due to λ_1 , coincides with $(n + 1)^{\text{th}}$ dark ring due to λ_2 . If radius of curvature of lens is 90 cm, find diameter of n^{th} dark ring for λ_1 . 5
- c) Derive the condition of bright and dark interference fringes due to reflected light from a parallel sided thin film. 5
- d) Derive expression for conductivity of an intrinsic semiconductor in terms of carrier mobility and carrier density. 5

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- e) Fringes of equal thickness are observed in a thin glass wedge of R. I. 1.52. Fringe spacing is 1 mm and wavelength of light is 5893 Å. Calculate angle of wedge in seconds of an arc.

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Module – II

3. a) Explain how ultrasonic waves are produced by magnetostriction oscillator. 5
 b) Describe any two methods for the detection of ultrasonic waves. 5
 c) Explain the construction and working of a magnetic lens. 5
 d) Draw a neat labelled diagram of Cathode Ray Tube. Explain how actual waveform of the signal is traced on the CRO screen with the help of time base generator. 10
4. a) Write a short note on ionization chamber. 5
 b) Write down five properties of ultrasonic waves. 5
 c) Describe acoustic diffraction method to find velocity of ultrasonic wave in liquid. 5
 d) Describe construction and working in electro-static lens. 5
 e) Explain piezoelectric method to produce ultrasonic waves. 5

SECTION – II (Chemistry)

Module – III

5. a) Draw a neat labeled diagram and explain how glass electrode can be used to find the pH of an unknown solution. 7
 b) What is a fuel cell ? Explain its basic set up. 6
 c) Explain how the following characteristics affect a battery system : 6
 i) voltage ii) capacity.
 d) Derive the equation to express the electrode potential for the following system Cu^{2+} (0.01M)/Cu and calculate its electrode potential at 25°C (Given $E^\circ \text{Cu} = 0.34 \text{ V}$). 6



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6. a) The following metals are provided Mg, AL and Cu and their metal salt solutions in concentrations of 0.1, 0.01 and 0.001 M are available. Using the above materials construct voltaic type cell that would give the highest cell potential and calculate the cell potential at 25°C (Given : $E^\circ \text{Mg} = -2.37\text{V}$, $E^\circ \text{Cu} = 0.34\text{V}$, $E^\circ \text{AL} = -1.66\text{V}$). 7
- b) Outline the construction of a calomel electrode and illustrate how it can be used to find the pH. 6
- c) With the help of a neat labelled diagram explain the construction and working of Alkaline fuel cell. 6
- d) Explain any three characteristics of a battery system. 6

Module – IV

7. a) An alloy made up of copper and zinc was found to undergo corrosion under service conditions. State and explain at least four possible modes of corrosion which may be due to inherent and external forces, this alloy can suffer corrosion. All possible conditions regarding metal and environment can be assumed. 8
- b) Describe how :
i) Nature of corrosion product
ii) Anodic and cathodic area and
iii) The electrode potential influence the rate of corrosion. 6
- c) What are the objectives of electroplating ? Give a brief account of electroplating of chromium. 6
- d) What are the advantages of electroless plating over electroplating. 5
8. a) Explain any four methods by which corrosion can be controlled or avoided. 8
- b) Describe the process of anodic metal coating with the help of a suitable example. 6
- c) Outline the various constituents of a electroless plating bath. 6
- d) Explain the process of electroplating with gold. 5