[Total No. of Questions : 8]

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F.E. (Semester - I) (Revised in 2007-08) Examination, Nov./Dec. - 2011
APPLIED SCIENCES - I (Physics & Chemistry)

Duration : 3 Hours **Total Marks : 100**

Instructions : 1) Answer one question from each module.
2) Answer physics and chemistry sections in separate answer books.
3) Draw diagrams wherever required.
4) Assume additional data if required.

SECTION - I

(Physics)

MODULE - I

Q1) a) A wedge shaped air film is formed between two glass plates by placing a paper at one of the sides. On illumination, by light of wavelength 6000 A°, this film gives 10 fringes in one cm. If the light is incident normally, find the angle of the wedge. **[5]**

b) Briefly discuss the concept of carrier diffusion in a semiconductors and hence derive an expression for total current density due to diffusion and drifting of charge carriers. **[5]**

c) Derive the condition for dark interference fringes due to transmitted light from a thin parallel film. **[5]**

d) What are Newton's rings? How are they formed? Show that radii of dark Newton's rings are propotional to square root of the natural numbers. Hence describe the method for determination of the wavelength of monochromatic light by Newton's rings method. **[10]**

Q2) a) How are colours exhibited by thin films when illuminated by an extended source? Show that the interference pattern of reflected and transmitted monochromatic sources of light in a thin film are complementary. **[5]**

b) The Hall coefficient of a doped silicon sample is found to be 3.66×10^{-4} m^3/c. The resistivity of the sample is 8.93×10^{-3} Ω m. Determine the mobility and density of charge carriers. **[5]**

c) What are antireflection films? Discuss the requirement of phase and amplitude condition and hence prove that the minimum thickness of ARF should be quarter wavelength thick. **[5]**

d) What is continuity equation? Derive equation of continuity for excess carrier in a semiconductor. **[10]**

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MODULE - II

Q3) a) Calculate the fundamental frequency of vibration when a quartz crystal of 0.15cm thickness is vibrating at resonance. **[5]**

Given : density of quartz = $2650 kgm^{-3}$.

Youngs modulus of quartz = $7.9 \times 10^{10} Nm^{-2}$.

b) Describe an experiment by which velocity of ultrasonic waves can be found out. **[5]**

c) Briefly explain basic principle of following : **[5]**

i) Magnetic lens.
ii) Cavitation.

d) Describe principle and working of a GM counter. State the physical significance of quenching carried out in it. How does a GM counter differ from a propotional counter? **[10]**

Q4) a) Describe principle and working of an Ionisation detector. How does it differ from a propotional counter? **[5]**

b) Explain the use of ultrasonic waves using : **[5]**

i) Echosounding.
ii) Cavitation.

c) Draw the block diagram of CRO and briefly explain its application to measure freqency of ac mains. **[5]**

d) State two methods for detection of ultrasonic waves. Give an account of piezoelectric method for production of ultrasonic waves. How is this method better than magnetostriction oscillator. **[10]**

SECTION - II

(Chemistry)

MODULE - III

Q5) a) Outline the construction of a Glass electrode and illustrate how it can be used to find the pH of unknown solution. **[8]**

b) Derive the equation to express the electrode potential for the following cu^{2+} $(x\mathrm{M})/cu$. **[6]**

c) Explain how the following characteristics affect a battery system : **[6]**

i) Voltage.
ii) Capacity.
iii) Operating temperature.

d) With the help of a neat labeled diagram explain the construction of the Z_n-air battery. **[5]**

Q6) a) The following metals are provided Mg, AC, and Cu and their metal solutions in concentrations of 0.1, 0.01, 0.001m are available. Using the above materials construct :

i) Voltaic type cell and

ii) Concentration cell that would give the highest cell potential and calculate the cell potential at 25°C (Given : E°Mg = – 2.37V, E° Cu = 0.34V, E° AC = – 1.66V). **[8]**

b) Define the following terms : **[6]**

i) Capacity of a Battery.

ii) Fuel cell.

iii) Electrode potential.

c) Outline the characteristics of the electrolyte in the following fuel cells : **[6]**

i) Phosphoric acid fuel cell.

ii) Solid polymer electrolyte fuel cell.

iii) Solid oxide fuel cell.

d) With the help of a neat diagram explain the construction of calomel electrode and outline the reactions involved therein. **[5]**

MODULE - IV

Q7) a) Describe the following : **[8]**

i) Galvanizing.

ii) Tinning.

b) Explain how the nature of the oxide film formed on the metal affects the rate of corrosion. Give examples. **[6]**

c) Explain 'Electroless plating of Nickel'. **[6]**

d) State and explain any two important characteristics which affect the electrodeposit obtained in electroplating. **[5]**

Q8) a) Explain the phenomenon of differential aeration corrosion with regard to pitting and waterline corrosion. **[8]**

b) Explain the basic set up of an electroplating bath with the help of a suitable example. **[6]**

c) Explain how a metallic structure can be protected against corrosion by having a proper design. **[6]**

d) Outline the various constituents of a Electroless plating bath. **[5]**

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