MODEL TEST PAPER-1

Subject: APPLIED PHYSICS I *Max Marks: 75*

Time: 3 hours

Question number 1 is compulsory. Attempt any one question from each unit.

1. Attempt any ten questions from the following:

(a) How would you obtain a sustained interference pattern with good contrast?

(b) D_1 and D_2 lines of sodium are $6A^0$ apart, what should be minimum number of lines in a diffraction grating to resolve these?

(c) Why is diffraction of sound waves more evident in our daily life than that of light wave?

(d) Calculate the minimum thickness of a calcite plate which would convert plane polarized light into circularly polarized light. The principal refractive indices for the ordinary and extraordinary rays are 1.658 and 1.486 respectively at wavelength 5890 A^0.

(e) Enunciate Malus law.

(f) What is population inversion? How is it achieved?

(g) Information carrying capacity of optical fiber system is more superior to copper cable system. Justify your answer.

(h) The mass of a moving electron is 11 times its rest mass. Find its kinetic energy and momentum?

(i) What is magnetostriction?

(j) The mean lifetime of a radioactive element is 14.43 months. Calculate the time required for 75% of the element to decay.

(k) Can a cyclotron be used to accelerate electrons? If not why? (2.5*10=25)

Unit-I

2. (a) Discuss the formation of interference fringes due to a wedge shaped thin film seen by normally reflected sodium light and obtain an expression for the fringe width. (6)

(b) Explain the need of extended source in interference with division of amplitude. (3)

(c) In a Newton's ring arrangement with a film observed light of wavelength $6x10^{-5}$cm, the difference of square of diameters of successive rings are $0.125cm^2$. What will happen if

(i) Wavelength of light is changed to $4.5x10^{-5}$cm.
(ii) A liquid of refractive index 1.33 introduced between lens and the plate.

(3.5)

3. (a) Find the ratio of the intensity of the secondary maximum that is adjusted to the central maximum relative to the central maximum for the single slit Fraunhofer diffraction pattern.

(8)

(b) Can D1 and D2 lines of Na(Sodium) light be resolved (for λ_{D1} = 5890 A^0 , λ_{D2}= 5896 A^0) in second order. Number of lines in grating of 2.0cm wide = 4500. (4.5)

Unit-II

4. **(a)** What is polarized light? How will you produce and detect plane, elliptically and circularly polarized light. (7.5)

(b) Describe the construction and theory of (i) Quarter-wave plate (ii) half-wave plate. (5)

5. **(a)** Explain the terms 'spontaneous emission' and 'stimulated emission' of radiation. Obtain a relation between transition probabilities of spontaneous and stimulated emissions. (5)

(b) Name the different classes of fibers. What are the light sources for optical fibers? Mention some advantages of fibers. (5)

(c) If the fractional difference between the core and cladding refractive indices of a fiber is 0.0135 and numerical aperture NA is 0.2425, calculate the refractive indices of core and cladding. (2.5)

Unit-III

6. **(a)** What is meant by Piezoelectric effect? Describe two methods for production of ultrasonic waves. What are the different applications of ultrasonic waves? (10.5)

(b) A quartz crystal of thickness 0.001m is vibrating at resonance. Find the fundamental frequency. Given Y for quartz = 7.9×10^{10} N/m^2 and ρ for quartz = 2650 Kg/m^3. (2)

7. **(a)** State the fundamental postulates of special theory of relativity. What was the objective of conducting the Michelson- Morely experiment? Describe the experiment. (5.5)

(b) What is meaning of mass energy equivalence? Obtain Einstein's mass energy relation. Prove the relation $E^2-p^2c^2=m_o^2c^4$ (5)

(c) A beam of particle of half life 2.0×10^{-8}sec travels in the laboratory with speed 0.96c. How much distance does the beam travel before the number of particle is reduced to half times of the initial value. (2)

Unit-IV

8. **(a)** What do you understand by radioactive disintegration and state the laws of radioactive disintegration. (5)

(b) Calculate the threshold energy required to initiate the reaction $P^{31}(n, p)\ Si^{31}$. Given m_p= 1.00814, m_n=1.00898, M_p=30.98356 and M_{si}=30.98515 in a.m.u. (2)

(c) What is nuclear fission? How does the liquid drop model of the nucleus enable us to understand this phenomenon? (5.5)

9. **(a)** Describe the principle, construction and working of a G.M. counter. What are its limitations? (10)

(b) A cyclotron's oscillator frequency is 10 MHz. What should be the operating magnetic field for accelerating proton? If the radius of its dees is 0.60m, what is the kinetic energy of the proton beam produced by the accelerator? Given e= 1.6×10^{-19} C, mp=1.67×10^{-27} kg. Express the result in units of MeV. (2.5)

MODEL TEST PAPER-2

Subject: APPLIED PHYSICS I Max Marks: 75

Time: 3 hours

Question number 1 is compulsory. Attempt any one question from each unit.

Q.1.a) Explain why in Newton's ring experiment fringes are circular with dark ring at the centre?

b) What is Rayleigh's criterion of resolution?

c) If unpolarised light falls on a system of two crossed polarized sheets, no light is transmitted if third polarized sheet is placed between them will light be transmitted. Explain

d) What will be the Brewster's angle for a glass slab (μ = 1.5) immersed in water(μ = 1.33)?

e) Can we have two level laser? Justify your answer

f) Explain the term mode related to optical fibre.

g) Write the postulate of special theory of relativity.

h) What is the speed of an electron having mass double of its rest mass?

i) What is piezo-electric effect?

j) Calculate the half life period of a radioactive substance if its activity drops $1/8^{th}$ of its initial value in 15 years.

k)Show by mass-energy calculations whether reaction $^{14}N(\alpha , p)\ ^{17}O$ and $^{7}Li(p, \alpha)\ ^{4}He$ are exothermic or endothermic. Given atomic masses of ^{14}N, ^{4}He, ^{17}O,^{7}Li and ^{1}H are 14.00753,4.00260,17.0450, 7.01822 and 1.00814 amu respectively. (2.5x10=25)

Unit-I

Q.2.a) What is a biprism? Give schematic diagram showing the formation of fringe using Fresnel's biprism.

b) Discuss the phenomenon of interference of light in thin films and obtain the conditions of maxima and minima. Show that the interference pattern in reflected and transmitted lights is complimentary.

c) In a Newton's ring experiment the diameters of 4^{th} and 12^{th} dark rings are 0.4cm and 0.8cm respectively. Deduce the diameter of 20^{th} dark ring. (3+7+2.5)

Q.3.a) Derive an expression for intensity of diffracted light in Fraunhofer diffraction at a single slit.

b) What is a grating? Deduce the expression for the dispersive power of grating

c) In a diffraction grating the width of opacities and transparencies are in the ratio 1:2. Find the absent spectra. (5+5+2.5)

Unit-II

Q.4.a) Describe Laurent's half shade polarimeter. How it can be used to find the specific rotation of an Optically active substance?

b) Distinguish between linearly, circularly and elliptically polarized light. Explain their production with the help of mathematical equations. (6+6.5)

Q.5.a) Explain the construction and working of He-Ne laser

b) Explain the difference between the step-index and graded-index fibre

c) Calculate the numerical aperture and hence acceptance angle for an optical fibre. Given that μ for core and cladding are 1.45 and 1.40 respectively (6.5+4+2)

Unit-III

Q.6.a) Describe Michelson-Morley experiment. Explain main conclusions.

b) What do you understand by the term time dilation? Discuss in brief its experimental proof. (7+5.5)

Q.7.a) What are Ultrasonic waves? Describe the piezoelectric method for producing ultrasonic waves and describe the application of ultrasonic waves in SONAR

b) In a laboratory two particles are observed to travel in opposite directions with speed 2.8×10^{10} cm/s. Deduce the relative speed of the particle. (8.5+4)

Unit-IV

Q.8.a) What do you mean by Q-value of a nuclear reaction. Derive an expression for Q-value of the reaction in terms of kinetic energies of the incident and product particles and masses of the various particles and nuclei. Assume that target nucleus is at rest.

b) Give the construction and working of a cyclotron. Derive an expression for the maximum kinetic energy achieved by a particle of mass m in terms of the applied magnetic field and the radius. (6+6.5)

Q.9.a) Distinguish between nuclear fission and fusion. Explain the principle of nuclear reactor.

b) Explain the construction and working of a Linear accelerator. (6+6.5)

MODEL TEST PAPER-1

Subject: APPLIED CHEMISTRY (ETCH-113)

Max Marks: 75 *Time: 3 hours*

Question number 1 is compulsory. Attempt any four questions from remaining five.

Q1.Attempt any five (3X5)

(a) Which substances are responsible for temporary hardness in water? How can it be removed? Explain with reactions.
(b) Discuss the significance of Proximate and Ultimate Analysis.
(c) Explain Catalysis by Wilkinson's Catalysis.
(d) Explain the terms Eutectic mixture and Eutectic point.
(e) Differentiate catalytic promoters and poisons with suitable examples.
(f) Write short note on electroplating.

Q2. (a) How do you determine the hardness of water by using EDTA method?
(b)Discuss caustic embrittlement in brief.
(c)Explain break-point chlorination.
(d) 100mL of water sample required 15mL of N/50 HCl upto phenolphthalein end-point. After this, methyl orange was added to this and further acid used was 10mL. Calculate the type and extent of alkalinity in water in terms of $CaCO_3$ in ppm. (5+3+3+4)

Q3. (a) Explain octane and cetane number with their significance.
(b)Differentiate GCV and NCV. Give Dulong's formula.
© A gaseous fuel undergoes combustion using 20% excess air. The composition of gaseous fuel by volume is as follows:
CH_4 = 5%, H_2= 20%, CO=25% and rest is N_2. Calculate the volume of air supplied for 100m^3 of the fuel and also determine the percentage composition of dry products. (5+3+7)

Q4. (a) Discuss the mechanism and kinetics of heterogeneous catalysis.
(b) Explain the terms phase, components and degrees of freedom with examples. (8+7)

Q5. (a) Draw and explain the phase diagram of Pb-Ag system. Discuss the Pattinson's process for desilverization of lead.
(b) Calculate the amount of lime (88.3% pure) and soda (99.2% pure) required to soften 24000 litres of water containing the following:
$CaCO_3$= 1.8mg/L, $MgSO_4$= 0.9mg/L, $CaSO_4$=0.34mg/L, $MgCO_3$=0.24mg/L, $MgCl_2$=0.76mg/L, SiO_2=2.3mg/L and NaCl=2.34mg/L (8+7)

Q6. (a) What is corrosion? Discuss the principle of chemical and electrochemical corrosion with suitable example.
(b) Write Pilling-Bedworth's rule.
© Explain the effect of following factors on the rate of corrosion:

(i) Nature of corrosion product
(ii) Cathodic and anodic area
(iii) pH
(iv) position in electrochemical series
(v) temperature and moisture

(8+2+5)

MODEL TEST PAPER-2

Subject: APPLIED CHEMISTRY (ETCH-113)

Max Marks: 75 *Time: 3 hours*

Question number 1 is compulsory. Attempt any four questions from remaining five.

Q1.Attempt any five (5x5)

(a) Explain Calgon conditioning and how is it better than phosphate conditioning?
(b) Explain knocking in petrol engine. Justify the statement that a good diesel fuel is bad fuel for petrol engine.
(c) Differentiate between Eutectic point and Triple point. Also explain Eutectic mixture is not a compound.
(d) Discuss in brief the Theories of catalysis.
(e) Explain Passivity. Why Iron corrodes faster than Aluminium even though Iron is placed below Aluminium in the Electrochemical series.
(f) Why water softened by Zeolite process unfit for use in boilers?

Q2.(a) Describe the manufacture of Coke by Otto- Hoffmanns process. (6+2.5+4)
(b) Differentiate LTC and HTC.

© A coal sample was found to have following composition C= 72%,H=8%,O=10%,N=6%and Ash=4%. Calculate the higher and lower calorific value of the coal sample.

Q3.(a) Describe the ion exchange process for softening/ demineralization of water in detail. (6+2+4.5)

(b) Explain why NH_3- NH_4Cl buffer solution is added during determination for Hardness of water by EDTA method.

© The total Hardness of 1000 litres of water was completely removed by a Zeolite softener. The Zeolite softener required 30 litres of NaCl solution,containing 15 gms/lts. Of NaCl for regeneration. Calculate the Hardness of water.

Q4(a). Draw and Explain Phase diagram of water system. (6+6.5)

(b) Explain the kinetics of Enzyme catalysis. Discuss the various cases.

Q5. (a) What is meant by Sacrificial Anodic protection in controlling corrosion. Why Impure Metal corrodes faster than pure Metal under identical conditions. (6+2.5+4)

(b)Explain why bolts and nuts made of the same metal is preferred in practice.

© Pure Zn granules do not liberate Hydrogen readily from dilute acids, but there is vigorous evolution of Hydrogen if the metal is in contact with Copper and Zinc.Give reason.

Q6. (a) Discuss the procedure for determination of Calorific Value of a solid fuel by Bomb Calorimeter with diagram.

(6+6.5)

(b) 50ml of a sample of water consumed 15ml of 0.01M EDTA before boiling and 5ml of the same EDTA after boiling. Calculate all types of Hardness in ppm.