Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER–III • EXAMINATION – SUMMER • 2014**

**Subject Code: 133503 Date: 28-05-2014**

**Subject Name: Applied Physics**

**Time: 02.30 pm - 05.00 pm Total Marks: 70**

**Instructions:**

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. ***Useful constants:*** $h = 6.626 \times 10^{-34}$ Js, $m_e = 9.1 \times 10^{-31}$ kg, $c = 3 \times 10^{8}$ m/s, $e = 1.6 \times 10^{-19}$C

**Q.1** **(a)** Discuss the de Broglie hypothesis of duality of material particles. Give in detail the experiment of Davisson and Germer in support of the hypothesis. **07**

**(b)** What is Mass Spectrograph? Explain in detail the principle, construction and working of Bainbridge Mass Spectrograph with neat diagram. **07**

**Q.2** **(a)** (i) State the Heisenberg's uncertainty principle. Give illustrations for pairs of linear position and momentum, energy and time; and angular momentum and angular position. **04**

(ii) Write down the final form of Schrodinger's time dependent and time independent wave equations. What does the wave function ψ signify? **03**

**(b)** (i) Find the threshold wavelength for photoelectric effect from copper, sodium, potassium and cesium surfaces. The work functions of these metals are *4.5eV, 2.3eV, 2.22eV* and *1.9eV* respectively. **04**

(ii) Write the properties of a wave function. **03**

**OR**

**(b)** A particle of mass *m* bounces back and forth in a cubical box with perfectly elastic sides of length *L*. Show that the particle possesses discrete energies given by $E_n = n^2h^2(8mL)^{-1}$, where *n* is an integer and write the normalized form of $\psi_n$ for corresponding energy state *n*. **07**

**Q.3** **(a)** (i) Draw a block diagram of Cathode Ray Tube. Write any two applications of Cathode Ray Oscilloscope. **05**

(ii) What is Lorentz force? Write down its mathematical expression. **02**

**(b)** Explain with neat diagram the principle and working of cyclotron. Mention the limitations on the energy achieved by a particle in the cyclotron. **07**

**OR**

**Q.3** **(a)** (i) Describe the Thomson's method to determine e/m of electron. **05**

(ii) An electron beam passes through magnetic field of $0.002 Wb/m^2$ and electric field of *34kV/m* both acting simultaneously at the same point. The path of electrons remains unchanged. Calculate the speed of electron. If the electric field is switched off, what will be the radius of circular path? **02**

**(b)** Discuss in detail the motion of an electron in uniform magnetic field. **07**

**Q.4** **(a)** (i) Explain how a charged particle fired into uniform electric field describes parabolic motion. What will happen if the electric field is NOT uniform? **05**

(ii) How is it possible for a charged particle to pass through a combination of electric and magnetic fields without any deviation? **02**

**(b)** Define (i) gloss (ii) diffuse reflection (iii) hue (iv) color temperature (v) lightness (vi) reflectivity (vii) absorption. **07**

**OR**

**Q.4** **(a)** What is the importance of Kubleka-Munk function? Explain in detail the Kubleka-Munk color mixing laws. **07**

**(b)** (i) Give the difference between light source and illuminants with examples. **05**

(ii) The molar extinction coefficient of a complex solution is $3.2 \times 10^3$ *L* $mol^{-1}$ $cm^{-1}$ at *240 nm*. Calculate the absorbance of a $5 \times 10^{-5}$ *M* solution and a $1 \times 10^{-4}$ *M* solution in *50 mm* cell when measured at wavelength of *240nm*. **02**

**Q.5** **(a)** (i) Write a note on color temperature. What is correlated color temperature? **04**

(ii) The absorbance of a solution containing two analytes was measured at two different wave lengths, $\lambda_1$ and $\lambda_2$ corresponding to maxima in absorption spectrum. The total absorbance was *0.678* at $\lambda_1$ and *0.890* at $\lambda_2$. The molar absorption coefficients for species *A* are *10 L* $mol^{-1}$ $cm^{-1}$ at $\lambda_1$ and *12 L* $mol^{-1}$ $cm^{-1}$ at $\lambda_2$. The cell path length was *1cm*. Calculate the concentration of species *A* and *B* assuming Beer's law behavior. **03**

**(b)** List and define any seven optical properties rendered by materials when light interacts with them. **07**

**OR**

**Q.5** **(a)** Discuss and derive the expression for the Beer-Lambert-Bouguer law for dilute solutions. Mention the important limitations of this law. **07**

**(b)** (i) What is color? How do we perceive color of any object? **03**

(ii) Write a note on molecular transitions and related spectroscopic techniques. **04**

**********