B. CHEM. ENGG. 2ND YR 1ST. SEM. SUPPL. EXAM.-2018(OLD)
Subject : PHYSICAL CHEMISTRY   Time : Three hours   Full Marks : 100
Part - I
Use Separate Answer scripts for each Part

1. (a) State briefly the properties of a typical black-body along with a suitable example. Using the Planck's result of black-body radiation density with frequency between ν and $\nu + d\nu$,

$$u(\nu)d\nu = (8\pi h/c^3). [\nu^3/\{\exp(h\nu/kT) - 1\}]. d\nu,$$

elaborate on its high and low frequency limiting values and show how the classical prediction of ultraviolet catastrophe is proved to be wrong.

(b) Describe briefly the Heisenberg's uncertainity principle. When a metal with work function 2.32 eV is irradiated with electromagnetic radiation of wavelength **308nm**, estimate the maximum possible speed of the ejected electron.

$$(2+6)+(3+3)$$

2. (a) Describe briefly two of the postulates of quantum mechanics. Calculate the de-Broglie wavelength of an electron traveling at 1.5.0% of the speed of light.

(b) Define hermitian operators and show that the eigen values of such operators are real.

$$(3+3)+(2+4)$$

3. (a) Evaluate the following commutators,

$$[p_x, x] \text{ and } [p_x^2, x] \quad (x \& p_x \text{ are position and momentum operators in one dimension}).$$

(b) Describe the Beer-Lambert law and state the reasons for which a photochemical system may show deviation from it.

$$2\times3+(2+4)$$

4. (a) For a free particle in a one-dimensional box of length `a ', the eigen functions are,

$$\Psi_n(x) = (2/a)^{1/2} \sin(n\pi x/a), \ n=1,2,3, ...$$

Evaluate the possible energy values for such a particle and give an estimate of the minimum frequency of radiation that can be absorbed by the particle.

(b) State what is the full form of **LASER**. Evaluate the most probable radial distance associated with the electron in the 1s orbital of a hydrogen atom. The 1s orbital wave function of the hydrogen atom is given as,

$$\Psi_{1s}(r) = (1/\sqrt{\pi}). (1/a_0)^{3/2}. \exp(-r/a_0). \quad (a_0 \text{ is Bohr radius}).$$

$$6+(1+5)$$

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B. E. CHEMICAL ENGINEERING SECOND YEAR FIRST SEMESTER (OLD)
SUPPLEMENTARY EXAMINATION - 2018

PHYSICAL CHEMISTRY

Part - II

1 (a) Show the steps followed to transform Weiss indices into Miller indices.

(b) If the Miller indices of a plane be 120, what are its Weiss indices?

(d) Among SCC, BCC and FCC which one is closest packed? Show its % occupancy.

$$3 + 2 + (1 + 4)$$

2 (a) Predict with logic whether an aqueous solution of sodium acetate will be acidic, neutral or basic.

(b) Calculate the pH of 10^{-8} (N) HCl solution.

(c) How would you prepare 10^{-8} (N) HCl solution from a given HCl solution which is 10 (N)?

$$4 + 3 + 3$$

3 (a) Describe an absolute method of determination of surface tension of a liquid.

(b) On what factors and how does the surface tension of a liquid depend?

$$6 + 4$$

4 (a) How does the coefficient of viscosity of a liquid vary with an increase in temperature?

(b) Describe a relative method of determination of the coefficient of viscosity of a liquid.

$$5 + 5$$

5 (a) With logic predict the curve for the conductometric titration of $AgNO_3$ solution with KCl solution, the latter being added from the burette.

(b) Predict with logic the nature of variation of conductance when HCl solution is titrated with NH_4OH solution the latter being added from the burette.

$$5 + 5$$