M.Sc. Semester I

CHE403 Physical Chemistry

Unit I- Chemical thermodynamics:

Nernst heat theorem and its applications to gaseous system, third law of thermodynamics and its applications to evaluate absolute entropics of solids, liquids and gases; partial molar quantities and their determination, Gibbs-Duhem equation, chemical potential, chemical potential of idea gases and solutions, Raoult's law, real solutions, free energy and solutions, activity and activity coefficients, methods of determination of activity and activity coefficients, fugacity of gases and liquids and methods of its determination.

Non equilibrium thermodynamics-basic concepts.

Unit II- Chemical Kinetics:

Unimolecular reactions, chain reactions and branched chain reactions, explosion limits, chain reaction between hydrogen and bromine, theory of absolute reaction rates, kinetic isotope effect.

Enzyme catalyzed reactions, mechanism, kinetics and some examples.

Unit III- Solid state chemistry:

Bonding in solids and electronic structure in solids, bond theory-metals, semiconductors and insulators, defects in crystals, calculation of schottly and Frenkel defects using statistical method, non stoichiometry, solid electrolytes, diffusion in solids, electrical conductivity in solids, super conductivity, perovskites.

Unit IV- Surface chemistry:

Physical and chemical adsorption, BET and HJ equations, heat of adsorption, determination of surface area of adsorbents, surface tension, Gibb's equation, surface active agents, micellisation, critical micellar concentration (cmc), detergency.

M.Sc. Semester II
CHE409 Physical Chemistry

Unit I Statistical thermodynamics:

Concepts of distribution of molecules, thermodynamic probability, permutations and combinations, Boltzmann's most probable distribution, partition function - translational, vibrational, rotational, electronic nuclear partition functions.

Unit II Nuclear chemistry:

Nuclear properties-nuclear radius, coulombic and nuclear potential radius, nuclear spin and angular momentum, magnetic moment, nuclear binding energy, nuclear models-shell model, liquid drop model, Fermi gas model, collective model, radioactive decay, nuclear reactions, evaporation, spallation, fragmentation, fission and fusion reactions, accelerators, reaction cross section, use of radioisotopes as tracers.

Unit III Polymer chemistry:

Kinetics and mechanism of polymer processes, criteria of polymer solubility, thermodynamics of polymer solutions, polymer characterization, molecular weight of polymer (number average and weight average) , methods of molecular weight determination, properties of polymers and applications.

Unit IV Electrochemistry:

Sign convention-American, European and IUPAC; Determination of dissociation constant of monobasic acids by conductometry, determination of dissociation constants of monobasic and polybasic acids by potentiometry.

The electrical double layer, the rate of charge transfer, polarization and overvoltage, basic principle of polarography, origin of different types of current; equation of polarographic wave, Ilkovic equation.

M. Sc. Semester I- References: Theory

(1) Textbook of physical chemistry – W.J.Moore

(2) Textbook of physical chemistry – Glasstone

(3) Textbook of physical chemistry – P.Atkins

(4) Advanced physical chemistry – Surdeep Raj

(5) Advanced physical chemistry – J.N.Gurtu, A.Gurtu

(6) Thermodynamics for chemists –Glasstone

(7) Physical chemistry – S. Castellian

(8) Thermodynamics of non equilibrium processes- Karapitianeh

(9) Chemical Kinetics- Laidler

(10) Chemical Kinetics – Frost and Pearson

(11) Solid state chemistry – H.Keer

(12) Solid state chemistry- Hannay

(13) Chemistry of solids – Azaroff

(14) Surface chemistry – Adamson

(15) Surface chemistry – Osipov

M. Sc. Semester II- References: Theory

(1) Textbook of physical chemistry – W.J.Moore

(2) Textbook of physical chemistry – Glasstone

(3) Textbook of physical chemistry – P.Atkins

(4) Advanced physical chemistry – Surdeep Raj

(5) Advanced physical chemistry – J.N.Gurtu, A.Gurtu

(6) Statistical thermodynamics – M.C.Gupta

(7) Polymer chemistry – Gowariker

(8) Polymer chemistry – Billmayer

(9) Principles of polymer science – Bahadur & Sastry

(10) Polymer science & technology – Fried

(11) Polymer chemistry- Malcolm P. Stevens

(12) Nuclear chemistry – Arniker

(13) Nuclear and radio chemistry – J.W. Kannedy, G.Friedlander

(14) Electrochemistry – Bockris and Reddy

M.Sc. Semester I -Practicals

CHE406PR Physical Chemistry

I. Conductometry

1. Titration of mixture of strong acid and weak acid with strong base (HCl + HAC against NaOH)
   Titration of mixture of strong acid and weak acid with weak base (HCl + HAC against H_4OH)
2. Solubility product of sparingly soluble salts – $PbSO_4$ & $BaSO_4$

II Potentiometry

1. Titration of mixture of strong (HCl) and weak (HAC) acid with NaOH / NH_4OH and find the strength of the acids in mixture.
2. Solubility product of silver halides.

III pH metry

1. Titration of mixture of strong (HCl) and weak (HAC) acid with NaOH / NH_4OH and find the strength of the acids.
2. Titration of mixture of bases (Na2CO3 & NaHCO3) with standard HCl and find the concentration of bases.

IV Adsorption and kinetics

1. Hydrolysis of esters
2. Reaction between $K_2S_2O_8$ and KI.

V Distribution method

1. Distribution of acetic acid between H_2O and butanol.
2. Distribution of HAC between H_2O and $CHCl_3$ / CCl_4.
3. Distribution of I_2 between H_2O and CCl_4.

M.Sc. Semester I - Physical Chemistry
Practicals- CHE406PR

References:

(1) Practical physical chemistry –J.B.Yadav

(2) Practicals in physical chemistry – P.S.Sindhu

(3) Experimental physical chemistry – R.C.Das, B.Behera

(4) Experiments in physical chemistry- P.H.Parsania, F. Karia

M.Sc. Semester II Practicals
CHE412PR Physical Chemistry

I. Conductometry

1. Test of validity of Ostwald's dilution law and determination of dissociation constant of weak electrolyte like CH3COOH & ClCH2COOH
2. Verification of Debye-Huckel-Onsager's equation in case of strong electrolytes like HCl, KCl, NaCl.

II Potentiometry

1. Titration of dibasic acid like malonic, oxalic, succinic acid with NaOH and find the dissociation constant of acid.
2. Precipitation titration $\rightarrow$ Titration of halids with $AgNO_3$.
3. Redox titration Ferrous ammonium sulfate –$KMnO_4$, $K_2Cr_2O_7$.

III pH metry

1. Determination of dissociation constant of weak acid like acetic and monochloroacetic acid

IV Adsorption and kinetics

1. Adsorption of acetic acid on activated charcoal
2. Determination of order of reaction between $K_2S_2O_8$ and KI by a fractional change method.

V Distribution method

1. Determination of the formula of the complex formed between cupric ion and ammonia by distribution method.

M.Sc. Semester II- Practicals
CHE412PR - Physical Chemistry

References:

1. Practical physical chemistry –J.B.Yadav
2. Practicals in physical chemistry – P.S.Sindhu
3. Experimental physical chemistry – R.C.Das, B.Behera
4. Experiments in physical chemistry- P.H.Parsania, F. Karia