Federal Urdu University

of Arts, Science and Technology

Syllabus
Physical Chemistry
(BS & MSc)
Department of Chemistry
2012

BS: 1st Year

Title of the Course: Physical Chemistry Code: CHEM-171
Credit Hours: (3+1) Marks: 100

1. Physical states of matter (8 credits)

- Ideal and real gasses
- Equation of state
- Derivation of general gas equation derivation of kinetic equation (kinetic theory of gasses)
- Vander Walls' equation
- Collision diameter
- Mean free path
- Collision number (derivation)

2. Chemical thermodynamic (11 credits)

- 1^{st} law of thermodynamics
- Mechanical work
- Derivation of work at constant pressure in isothermal reversible and irreversible process.
- Enthalpy
- Relation between ΔE and ΔH
- Heat capacity
- $C_p - C_v = R$
- 2^{nd} law of thermodynamics
- Carnot cycle
- Entropy
- Derivation of change in entropy in isothermal reversible process

3. Chemical kinetics (11 credits)

- Rate of reaction
- Rate law
- Order and molecularity
- Zero order reaction
- 1^{st} order reaction
- Methods for determination of order of reaction
- Concept of chemical equilibrium
- Equilibrium constant
- Example :HI and PCl_5 reactions
- Le Chatelier's Principle
- Relation b/w K_c and K_p

4. Solution chemistry (5 credits)

- Ideal and non-ideal solution
- Raoult's law
- Colligative properties
- Derivation of lowering of vapour pressure, elevation of boiling point
- Depression in Freezing point (from Clausius Clapeyron equation)

5. Surface chemistry (5 credits)

- Absorption and Adsorption
- Langmuir adsorption isotherm
- Phase Rule
- Water System
- Preparation, properties and use of colloids.

6. Electrochemistry (5 credits)

- Arrhenius theory of ionization
- Conductance, types of conductance
- Application of conductance measurement
- Conducto metric titration

Practical

Fifteen experiments shall be conducted based on the following:

1. Relative viscosity
2. Parachor volume
3. 1st order
4. Unknown by viscometer
5. Molar refeactometer
6. Unknown by refeactometer
7. To find out the normality of strong base with strong acid by condutometric method.

Recommended Literature

1. Alberty R. "Physical Chemistry" 17th ed., John Wiley and Sons (1987).
2. Atkins, P.W. "Physical Chemistry" 6th ed., W.H. Freeman and Co. New York (1998).
3. Laidler K.J. "The World of Physical Chemistry" 1st ed., Oxford University Press (1993).
4. Laidler K.J., John H.M. and Bryan C.S. "Physical Chemistry" 4th ed., Houghton Mifflin Publishing Company Inc.(2003).

5. Peter P.A. “Chemical Thermodynamics” Oxford University Press (1983).
6. Brain S.E. “Basic Chemical Thermodynamics” 4th ed., E.L.B.S. Publishers (1990).
7. Barrow G.M. “Physical Chemistry” 5th ed., McGraw Hill (1992).

BS 3rd Year, Semester-V
M.Sc. (Previous), Semester-I

Title of the Course: Physical Chemistry Code: CHEM-271
Credit Hours: (3+1) Marks: 100

1. Atomic structure and elementary quantum chemistry (15 credits)

- System description of hydrogen like atoms.
- Bohr's theory of hydrogen like atoms.
- Rydberg's equation.
- Atomic spectra.
- Photoelectric and Compton effects.
- Wave nature of matter.
- Nature of EMR.
- Coherent.
- Interference constrictive and distractive.
- Polarization of EMR.
- De Broglie Wave length.
- Heisenberg uncertainty principle.

2. Kinetic and molecular theory of gases (8 credits)

- Postulate of the theory.
- PV- KE relation.
- Maxwell Velocity distribution.
- Collision parameters such as velocity.
- Mean free path.
- Collision numbers and diffusion.

3. Electrochemistry (12 credits)

- Oxidation Reduction reactions.
- Stoichiometry of Redox Redaction.
- Balancing of equation by.
- 1-ion electron method.
- 2- Oxidation reduction reactions.
- Electrolysis.
- Galvanic cell.
- Nernst equation.
- Cell potential and spontaneity of the reaction
- Relation between cell potential and free energy change.
- Relation between cell potential and equilibrium constant

4. Structure of nucleus (10 credits)

- Nuclear constituent.
- Nuclear size.
- Binding energy.
- Nuclear shell.
- Shell model states
- Nuclear cross sections.
- Nuclear spin and moments.
- Bose-Einstein static and Fermi energetic.
- Fission and fusion.
- Nuclear reactors.

Practical

Fifteen experiments shall be conducted based on the following:

1. Determination of molecular weight of a polymer by viscosity method.
2. To find out the amount of CU^{+2} ion by spectrophotometer titration.
3. To determine the heat of solution of benzoic acid.
4. To find out the dissociation constant of CH_3COOH by Henderson equation.
5. To find out the mole ratio of Cu-EDTA Complex by Conductometeric titration.
6. Determination of percentage Composition of $KMnO_4/k_2Cr_2O_7$ in a given solution by spectrophotometer.

Recommended Literature

1. Alberty, R. A., Robert J.S. and Moungi G. B. " Physical Chemistry". 4th ed, John Wiley and Sons (2004).
2. Ball, D W., "Physical Chemistry" 1st ed., Brooks/Cole Co. Inc. (2003).
3. Engel, Thomas and .Reid p., "Thermodynamics, Statistical Thermodynamics, and Kinetics" 1st ed., Benjamin Cummings (2006).
4. James K. and Wothers, P., "Why Chemical Reactions Happen". Oxford University Press (2003).
5. Smith, E. Brain, "Basic Chemical Thermodynamics" 5th ed., Imperial College Press (2004).
6. Stephen B. R., Rice S. A. and Roses J., "Physical Chemistry"2nd ed., Oxford University Press (2000).
7. Jurg W., "Basic Chemical Thermodynamics" W. A. Banjamin (1969).
8. Chorkendorff, I. and Niemantsverdriet, J.W. "Concept of Modern Catalysis and Kinetics" 1st ed., John Wiley and Sons (2003).
9. Espenson, J. H. " Chemical Kinetics and Reaction Mechanism" 2nd ed., McGraw Hill (2002).
10. Berry R. S., Stuart A.R., and Roses J. " Physical and Chemical Kinetics" 2nd ed., Oxford University Press (2000).

BS 3rd Year Semester-VI
M.Sc. (Previous), Semester-II

Title of the Course: Physical Chemistry Code: CHEM-371
Credit Hours: (3+1) Marks: 100

1. **Thermodynamic (21 credits)**
   - Nature of thermodynamics.
   - Determination of E.
   - Reversible and irreversible processes.
   - Work done for expansion and cons traction of a system.
   - Properties of the state function.
   - Dependence of internal energy and enthalphy on pressure.
   - Heat capacity of ideal gases.
   - Adiabatic expansion of ideal gasses.
   - Internal energy and enthalpy changes in chemical standard heat of formation.
   - Reversible work in cyclic processes.
   - Enthalpy and energy and its calculation.
   - Gibbs free energy and its calculation.
   - Dependence of free energy on temperature and pressure.
   - The fugacity.
   - Qualitative treatment of phase equilibrium (Clausius-clapeyron equation).

2. **Chemical Kinetics (12 credits)**
   - Order and molecularity or reaction
   - Second and third order reaction with same and different initial concentration
   - Opposing reaction
   - Effect of temperature
   - Activated complex
   - Unimolecular and bimolecular collision theory
   - Transition state theory

3. **Photochemistry (12 credits)**
   - Photochemical law
   - Fluorescence and phosphorescence
   - Quantum efficiency
   - Law of photochemical equivalence
   - The primary light absorption
   - H_2-Cl_2 reaction
   - H_2-Br_2 reaction

Practical
Fifteen experiments shall be conducted based on the following:

1. To determine relative strength of two acids by hydrolysis of an ester.

2. Kinetic of saponification of ethyl acetate.

3. To determine the equilibrium constant between carboxylic acid and alcohol.

4. To determine the equilibrium constant of the reaction between potassium iodide and iodine.

5. To determine the distribution co efficient of benzoic acid on CCl_4 and H_2O.

Recommended Literature

1. Cotton F.A. “Chemical Applications of Groups Theory” Interscience Publishers (1963).
2. Lowell Hall H. “Group Theory and Symmetry in Chemistry” McGraw Hill Book Company (1969).
3. Albert R.A., Robert J.S. and Moungi G.B. “Physical Chemistry”. 4th ed., John Wiley and Sons (2004).
4. Ball D.W. “Physical Chemistry” 1st ed., Brooks/Cole Co. Inc. (2003).
5. Calvert J.G. and Pitts J.N. “Photochemistry” John Wiley, New York (1966).
6. Suppan P. “Principles of Photochemistry”, The Chemical Soc., UK (1973).
7. Vertes A. “Basics of Nuclear Science” Kluwer Academic Publisher London (2003).
8. Friedlander G. and Kennedy J.W. “Nuclear and Radiochemistry” 3rd ed., Wiley, New York (1981).

BS 4th Year Semester-VII
M.Sc. (Final), Semester-I

Title of the Course: Chemical Kinetics/Polymer Chemistry

Code: CHEM-472

Credit Hours: (4+0) Marks: 100

1. The Empirical framework of chemical kinetics (10 credits).

- Introduction
- The rate equation
- Integrated rate equations
- Reaction half-life and mean lifetime
- The determination of reaction order
- Effect of temperature on reaction rates

2. The Experimental study of reaction kinetics (10 credits).

- An elementary reaction and the molecularity.
- Consecutive reaction process.
- Formation of an intermediate complex.
- Parallel reactions.
- Reactant participating in equilibrium
- Opposing reactions.

3. Theories of Bimolecular reactions (10 credits)

- The collision theory.
- Transition state theory
- The theory of diffusion-controlled reactions in solution

4. The Interpretation of Bimolecular reactions in Solution (10 credits)

- Solvent effects on reaction rates.
- Applied hydrostatic pressure.
- Dielectric permittivity.
- Ionic strength.
- Linear free energy relationship.
- Kinetic isotope effects.
- Electron transfer reactions in solution

5. Polymer Chemistry (20 credits)

- Basic concept of Polymer Sciences.
- Classification of Polymers
- Degree of Polymerization or chain length
- Condensation Polymerization (Step- Growth Polymerization)
- Formation of Polyester
- Kinetics of Step Growth Polymerization
- Relationship between degree of Polymerization
- Functionality extent of reaction (Carothers's equation.)
- Composite Materials(Polymer properties enhancement by reinforcement)
- Metrics and Reinforcement
- Composites with Metallic Matrices (MMCs)
- Ceramics Matrix Composites (CMCs)
- Polymer Matrix Composites (PMCs)
- Factors which determines the properties of the composites
- The benefits of composites(Uses of Composites)

Recommended Literature

- Logan S.R, 1984 introductory reaction kinetics-an unacknowledged difficulty. Education in chemistry, 21, 20-22.
- Laidler, K.J.1985 Chemical kinetics and the origins of physical chemistry .Arrhenius equation. Journal of chemical Education 61,494-98.
- Logan, S.R, 1982.The origin and status of the Arrhenius Equation. Journal of chemical Education, 59,279-81.
- Espenson J.H, 1995. Chemical kinetics and reaction Mechanisms,2nd edition. New York: McGraw-hill.
  Albery, W.J 1993.Transition state theory revisited. Advances in physical organic chemistry.28, 139-70.
- Perlmutter-Hayman, B, 1971.The primary kinetic salt effecting aqueous solution. Progress in Reaction Kinetics, 6239-67.
- Hammett, L. P, physical Organic Chemistry, 2nd edition .New York: Mc Graw-Hill.
- Marcus, R.A1993.Electron transfer reaction in chemistry .Theory and experiment Reviews of modern Physics, 65,599-610.
- P.Ghosh, Polymer Science and Technology,2nd edition, Tata McGraw Hill, Delhi 2002
- F.W Billmeyer, Textbook of Polymer Scienc,3rd edition, John Willey, Delhi,2002
- M.S Bhatnagar, A Text Book of Polymers, 1st edition, S.Chand, Delhi 2004

BS 4th Year Semester-VII
M.Sc. (Final), Semester-I

Title of the Course: Spectroscopy/Quantum Chemistry
Code: CHEM-473

Credit Hours: (4+0) Marks: 100

Quantum Chemistry (35 credits)

Black body radiation, photoelectric effect, solution of differential equations, postulates of quantum mechanics, operators, properties of operators, linear operators, hermitian operators, eigen functions of hermitian operators are orthogonal, harmonic oscillator obey Hooke's law, energy of harmonic oscillator is conserved, Schrodinger equation of harmonic oscillator,energy level of quantum mechanical harmonic oscillator, harmonic oscillator wave functions involve hermite polynomials, average kinetic energy and average potential energy of harmonic oscillator are equal, harmonic oscillator and infrared spectrum, three dimensional system, energy level of rigid rotator, laplacian operator, rigid rotator is a model for a rotating diatomic molecules, wave functions of rigid rotator are spherical harmonics, operators corresponding to three components of angular momentum do not commute.

Spectroscopy (25 credits)

Different region of EMR are used to investigate different molecular process, rigid rotator is the model of molecular rotation, harmonic oscillator is the model of molecular vibration, rotational transitions accompany vibrational transition, line in a rotational spectrum are not equally spaced, overtones in vibrational spectra, electronic spectra contain both vibrational and rotational information,

Recommended Literature

1. Donald.A.McQuarrie, quantum chemistry
2. Silbey and Alberty, physical chemistry

BS 4th Year Semester-VII
M.Sc. (Final), Semester-I

Title of the Course: Surface chemistry/Surfactant Code: CHEM-474
Credit Hours: (4+0) Marks: 100

Surface Chemistry (30 credits)

- Adsorption Surface and interface.
- Interfacial tension.
- Adsorption forces thermodynamics of adsorption.
- Particle size distribution.
- Physisorption and chemisorption adsorption.
- Isotherms and their types (Freundlieh, Langmuir, BET etc)
- Force field in fine pores.
- Microporosity
- Homogeneous and heterogenous catalysis
- Gas-solid interface.
- Enzyme catalysis.
- Gas reaction at solid surfaces.
- Diffusion limitation and compensation effect.

Recommended Literature

- G.C. Bond heterogeneous Catalysis: Principle and application 2nd edition, Clarendon Press Oxford(1987).
- S.J.Gregg and K.S.W. Sing, Adsorption, Surface Area and Porosity, 2nd edition, Academic Press, London 1982.

Surfactants (30 credits)

- Classification
- Micellization
- Solubilization
- Critical micelle concentration
- Emulsion stability
- Aging and inversion of emulsion
- Hydrophile-lipophile balance
- Micro emulsion
- Wetting and contact angle
- Colloidal solution
- Rheology of dispersion

- Measurement of flow of materials
- Study of deformation and flow of matter.
- Definitions i) Designing an experiment , ii) Geometry , viscometery.
- Shear thinning and thickening behavior
- Plastic models
- P seudoplastic models
- Scattering and reflection techniques
- Principle of scattering experiment
- Dynamic and static light scattering.

Recommended Literature

- A.W. Adamson, Physical chemistry of Surfaces 5th edition, Wiley-Inter science Publication, John Wiley and sons, Inc., NewYork 1990
- P.C.Hiemenz . and Rajagopalan, Principles of Collide and Surface chemistry, 3rd edition Marcel Dakker Inc.,New York 1997.
- M.J. Rosen, Surfactant and Interfacial Phenomena, Wiley-Interscience Publication, John Wiley & Sons, New York 1978.

BS 4th Year Semester-VII
M.Sc. (Final), Semester-I

Title of the Course: Advanced Practical Code: CHEM-471
Credit Hours: (0+4) Marks: 100

Spectroscopy/ Kinetics
Experiments to be designed relevant to theory course.

BS 4th Year Semester-VIII
M.Sc. (Final), Semester-II

Title of the Course: Electrochemistry Code: CHEM-572
Credit Hours: (4+0) Marks: 100

Fundamentals of electrochemistry (02 credits)
Real concept of current, charge and potential. Conventions in electrochemistry, Potential convections, Current convections, The Relation of current density to current rate.

Ionics (06 credits)
Ions in solution, solvent structure (associated, unassociated solvents), Suitable solvents for electrochemistry, Ion-Solvent interactions (salvation), Ion-ion interactions, Solvent polarity the dipole moment and dielectric constant.

Electrified interface (08 credits)
The Structure of electrified interface, The parallel Plate condenser Model the Helmohltz Perin theory, The Ionic cloud the Gouy -Chapman diffuse charge Model of the double layer, The Stern Model of double layer, Faradic and nonfaradic processes, The ideal polarized electrode, Capacitances and charge of an electrode, Double layer Charging Current.

Modes of Mass Transfer (03 credits)
Modes of Mass Transfer Migration, diffusion, convection, Fick's laws of diffusion, Nernst-Planck equation.

Cyclic voltammetry (14 credits)
Cyclic voltammetery, Current potential relationship, Basic cyclic voltammetric parameters, Derived cyclic voltammetric parameters, Reversible process, Quasi-reversible process, Irreversible process, Electrochemical cells, Cell resistance, Uncompensated Resistance, Reduction of Solution, Uncompensated resistance, Supporting Electrolytes, Type of electrodes, Working electrodes, Reference electrode, Counter electrodes, General Factors Affecting the current WE, Diffusion coefficients and their determination.

Electrode Kinetics (06 credits)
Chemical coupled reactions, Homogenous rate constant, Heterogeneous electron transfer rate constant, Butler- Volmer Equation, Over Potential, The Empirical Tafel Equation, and The Marcus Theory of charge Transfer.

Cell design (04 credits)
Polarography Two Electrode circuit (cell design), Problem associated with two electrode circuits, Three electrode circuit (cell design), Potentiostatic control.

Fundamental equations (04 credits)
Nernst equation, Cottrel Equation, Equilibrium Constant, Rendles ServiK equation, The Ilkovic Equation (current -analyte concentration in the bulk solution).

Important electrochemical techniques (13 credits)

Digital Simulations, Ultramicroelectrodes, The Unique Features of Microelectrodes, Enhancement of Diffusion at a microelectrodes, Spectroelectrochemistry, Bulk electrolysis, Cathodic stripping voltemetry, Electrochemical Impendence Spectroscopy (EIS), Rotating Disk electrode, Pulse voltammetry, Scanning electrochemical microscopy (SEM), Biological application of (SEM), Nanotechnology in Electrochemistry, Cellular electrochemistry and the production of ATP.

Recommended Literature

1. J. O. M. Bokris and A. K. N, Reddy “Modern Electrochemistry”, 2nd Ed, **2000**.

2. Allen J. Bard, and L. R. Faullencener," Electrochemical Methods", 2nd Ed, Wiley, New York , **2004**.

3. D. T. Sawyer, A. SobKowiak and J. L. Roberts, "Electrochemistry for Chemists", 2nd Ed, John Wiley,New York,**1995**.

4. E. Gileadi, “Physical Electrochemistry Fundamentals, Techniques and Applications” Wiley-VCH, Germany, **2011**.

5. P. Atkins, and J. De Pauler,"Physicail Chemistry ".Oxford University Press, **2010**.

6. Allen J. Bard, G. Inzelt, and F. Scholz, “Electrochemical Dictionary” Springer, **2008**.

7. Bard-Stratmann” Encyclopedia of Electrochemistry” Vol. 1-10, Wiley-VCH, Germany, **2006.**

8. D. W. Ball, “Physical Chemistry" Thomson, Brooks/Cole, USA, **2003**.

9. H. H. Girault, "Analytical and Physical Electrochemistry ", EPFL Press, Switzerland, **2004**.

10. M. S. Silberberg, “Chemistry the Molecular Nature of Matter and Change" 3rd Ed, Mc Graw Hill USA, **2003**.

11. T. L. Brown, H. E. LeMay, and B. E. Bursten , “Chemistry the Central Science”,10th Ed., **2006**.

12. P. Zanello, “Inorganic Electrochemistry Theory, Practice and Application” Royal Society of
Chemistry, **2003**.
13. J. Wang, “Analytical Electrochemistry” 3rd Ed. Wiley-VCH, USA, **2006**.
14. C. M. A. Brett and A. M. O. Brett, “Electrochemistry Principles, Methods and Applications” Oxford
University Press, **1994**.
15. V. S. Bagotsky, “Fundamentals of Electrochemistry” 2nd Ed. Wiley USA, **2006**.
16. C. H. Hamann, A. Hamnet, and W. Vielstich, “Electrochemistry” 2nd Wiley-VCH, Germany, **2007**.
17. P. H. Rieger, Electrochemistry Principles, Methods and Applications” , 2nd Ed. Chapman and Hall,
New York, **1993**.
18. D. K. Gosser, “ Cyclic Voltammetry Simulation and Analysis of Reaction Mechanisms” Wiley-VCH,
USA, **1993**.
19. R. G. Hicks, “Stable Radicals” Wiley, UK, **2010**.
20. L. S. Santos, “Reactive Int

BS 4th Year Semester-VIII
M.Sc. (Final), Semester-II

Title of the Course: Radio/Radiation chemistry Code: CHEM-573
Credit Hours: (4+0) Marks: 100

Properties of nucleus, density of nucleus, mass defect, binding energy of nucleus, band of stability, neutron- proton ratio, radioactivity, types of radioactivity, alpha decay, negatron decay, positron decay, electron capture decay, gamma emission, decay scheme of radioisotopes, law of radioactivity, half life, decay constant, **(10 credits)**

Units of activity, conversion of Becquerel into Curie, disintegration per second, count per second , carrier and specific activity, relation between mass and activity, **(4 credits)**

Preparation of radioisotopes, labeling with Carbon-14,radiation detection and counting-scintillation methods, radiation protection, radiation dosimetry, dose rate, dose equivalent, quality factor Q, gamma radiation dose constant, beta radiation dose constant, absorption coefficient and half thickness of material, statistics of counting radioactive samples, radioimmunoassay, types of nuclear reactions, neutron capture reaction, nuclear cross section, unit of nuclear cross section,, fission and fusion reactions, total angular momentum of nucleus, magnetic moment of nuclei, gyromagnetic ratio, interaction of gamma radiation with matter ,radiation sources, radiation dosimetry. Types of dosimetry, ionization chamber dosimetry, film dosimetry, luminescence dosimetry, **(12 credits)**

Dose rate, dose equivalent, quality factor Q, gamma radiation dose constant, beta radiation dose constant, absortion coefficient and half thickness of material, statistics of counting, radioactive samples, determination of age of the rock, tracer investigation methods, gravimetric methods, efficiency of precipitation, isotope dilution analysis, **(20 credits)**

Activation analysis method, neutron activation, radioimmunoassay, types of nuclear reactions, neutron capture reaction, nuclear cross section, unit of nuclear cross section, fission and fusion reactions, total angular momentum of nucleus, magnetic moment of nuclei, gyromagnetic ratio, interaction of gamma radiation with matter, gamma spectroscopy, compton effect, photoelectric effect and pair production, **(14 credits)**

Recommended Literature

1. Gorden Hughes, Radiation chemistry
2. W.Geary, Radiochemical methods
3. Jagdish Varma, fundamentals of nuclear physics

BS 4th Year Semester-VIII
M.Sc. (Final), Semester-II

Title of the Course: Chemical Thermodynamics / Statistical Mechanics
Code: CHEM-574
Credit Hours: (4+0)
Marks: 100

STATISTICAL THERMODYNAMICS (30 credits)

- Preliminary ideas of thermodynamics
- Function Maxwell's distribution of kinetic energy
- Statistical Boltzmann's distribution energies concept of partition function
- Types of partition functions
- Translation vibrational, rotational & electronic partition functions
- Difference of heat capacities at constant pressure and volume in terms of partition function
- Maxwell's relations
- Entropy and probability
- Statistical treatment of entropy
- Sackur-Tetrode equation
- Entropy in terms of internal energy and partition function
- Enthalpy in terms of partition function
- Third law of thermodynamics
- Work function and free energy
- Gibbs Helmholtz equation
- Free energy in terms of partition function
- Vant Hoff isotherm in terms of partition function
- Fugacity of gases
- Temperature dependence of equilibrium constant

THE KINETIC ANALYSIS OF EXPERIMENTAL DATA (30 credits)

- The Experimental Data

- Dependence of Rate on Concentration
- Meaning of the Rate Expression
- Units of the Rate Constant, *k*
- The Significance of the Rate Constant as Opposed to the Rate
- Determining the Order and Rate Constant from Experimental Data
- Systematic Ways of Finding the Order and Rate Constant from Rate/Concentration Data
- A Straightforward graphical method
- Log/log graphical procedure
- Drawbacks of the Rate/Concentration Methods of Analysis
- Integrated Rate Expression
- Half-lives
- First Order Reactions
- The half-life for a first order reaction
- An extra point about first order reactions
- Second Order Reactions
- The half-life for a second order reaction
- An extra point about second order reactions
- Zero Order Reaction
- The half-life for a zero order reaction
- Integrated Rate Expressions for Other Orders
- Main Features of Integrated Rate Equations
- Pseudo-order Reactions
- Application of pseudo-order techniques to rate/concentration data
- Determination of the Product Concentration at Various Times
- Expressing the Rate in Terms of Reactants or Products for Non-simple Stoichiometry
- The Kinetic Analysis for Complex Reactions
- Relatively simple reactions which are mathematically complex
- Analysis of the simple scheme A $\overset{k1}{\rightarrow}$ $\underset{k2}{\rightarrow}$ P
- Two conceivable situations

- The Steady State Assumption
- Using this assumption
- General Treatment for Solving Steady States
- Reversible Reactions
- Extension to other equilibria
- Pre-equilibria
- Dependence of Rate on Temperature

Recommended Literature

1. Gasser R.P.H. and Richards W.G. “Entropy and Energy Levels” Oxford University Press (1974).
2. Wayatt P.A.H. “The Molecular Basis of Entropy and Chemical Equilibrium” Royal Institute of Chemistry London (1971).
3. Smith E.B. “Basic Chemical Thermodynamics” 4th ed. Oxford University Press (1990).
4. Bockris J.O.M. and Reddy A.K.N. “Modern Electrochemistry” Vol-I and II, 4th ed. Plenum Press, London (2003).
5. Muhammad M. and Amjad M. “Principles of Electrode Kinetics” Rooha Printers, Lahore (2001).
6. Seddon J.M. and Gale J.D. “Thermodynamics and Statistical Mechanics” Royal Soc Chem, UK (2002).
7. Aston J.G. and Fritz J.J. “Thermodynamics and Statistical Thermodynamics” John-Wiley, New York (1987).
8. Albery J., Electrode Kinetics, Clarendon, Oxford (1975).
9. Engel, Thomas and Philip Reid, “Thermodynamics, Statistical Thermodynamics”, and Kinetics1st ed., Benjamin Cummings (2006).
10. Bard A.J. and Faulkner L.R. “Electrochemical Methods” John Wiley & Sons (2001).

BS 4th Year Semester-VIII
M.Sc. (Final), Semester-II

Title of the Course: Advanced Practical Code: CHEM-571
Credit Hours: (4+0) Marks: 100

Electro chemistry / Solution chemistry

Experiments to be designed relevant to theory course