T.Y.B.Sc. CHEMISTRY (6 UNITS)
Choice Based Credit System
To be implemented from the Academic year 2018-2019

SEMESTER V

PHYSICAL CHEMISTRY

COURSE CODE: USCH502 **CREDITS: 02** **LECTURES: 60**

UNIT	TOPIC	NO. OF Lectures
UNIT I	1.0 MOLECULAR SPECTROSCOPY	15L
	1.1 **Rotational Spectrum**: Introduction to electromagnetic radiation, polarization of a bond, bond moment, molecular structure, .Rotational spectrum of a diatomic molecule, rigid rotor, moment of inertia, energy levels, conditions for obtaining pure rotational spectrum, selection rule, nature of spectrum, determination of internuclear distance and isotopic shift. 1.2 **Vibrational spectrum**: Vibrational motion, degrees of freedom, modes of vibration, vibrational spectrum of a diatomic molecule, simple harmonic oscillator, energy levels, zero point energy, conditions for obtaining vibrational spectrum, selection rule, nature of spectrum. 1.3 **Vibrational-Rotational spectrum of diatomic molecule**: energy levels, selection rule, nature of spectrum, P and R branch lines. Anharmonic oscillator - energy levels, selection rule, fundamental band, overtones. Application of vibrational-rotational spectrum in determination of force constant and its significance. Infrared spectra of simple molecules like H_2O and CO_2. 1.4 **Raman Spectroscopy :** Scattering of electromagnetic radiation, Rayleigh scattering, Raman scattering, nature of Raman spectrum, Stoke's lines, anti-Stoke's lines, Raman shift, quantum theory of Raman spectrum, comparative study of IR and Raman spectra, rule of mutual exclusion- CO_2 molecule.	
UNIT II	2.0 CHEMICAL THERMODYNAMICS	10 L
	2.1.1 **Colligative properties:** Vapour pressure and relative lowering of vapour pressure. Measurement of lowering of vapour pressure - Static and Dynamic method.	
	2.1.2 **Solutions of Solid in Liquid:** 2.1.2.1 Elevation in boiling point of a solution, thermodynamic derivation relating elevation in boiling point of the solution and molar mass of non-volatile solute.	

	2.1.2.2 Depression in freezing point of a solution, thermodynamic derivation relating the depression in the freezing point of a solution and the molar mass of the non-volatile solute. Beckmann Method and Rast Method. 2.1.3 **Osmotic Pressure :** Introduction, thermodynamic derivation of Van't Hoff equation, Van't Hoff Factor. Measurement of Osmotic Pressure - Berkeley and Hartley's Method, Reverse Osmosis.	
	2.2 CHEMICAL KINETICS	5 L
	2.2.1 **Collision theory of reaction rates** : Application of collision theory to 1. Unimolecular reaction Lindemann theory and 2. Bimolecular reaction. (derivation expected for both)	
	2.2.2 Classification of reactions as slow, fast and ultra -fast. Study of kinetics of fast reactions by Stop flow method and Flash photolysis (No derivation expected).	
UNIT III	3.0 NUCLEAR CHEMISTRY	15L
	3.1. **Introduction**: **B**asic terms-radioactive constants (decay constant, half life and average life) and units of radioactivity	
	3.2 **Detection and Measurement of Radioactivity:** Types and characteristics of nuclear radiations, behaviour of ion pairs in electric field, detection and measurement of nuclear radiations using G. M. Counter and Scintillation Counter.	
	3.3 **Application of use of radioisotopes as Tracers :** chemical reaction mechanism, age determination - dating by C14.	
	3.4 **Nuclear reactions**: nuclear transmutation (one example for each projectile), artificial radioactivity, Q - value of nuclear reaction, threshold energy.	
	3.5 **Fission Process :** Fissile and fertile material, nuclear fission, chain reaction, factor controlling fission process. multiplication factor and critical size or mass of fissionable material, nuclear power reactor and breeder reactor.	
	3.6 **Fusion Process :** Thermonuclear reactions occurring on stellar bodies and earth.	
UNIT IV	4.1 SURFACE CHEMISTRY	6L
	4.1.1 **Adsorption:** Physical and Chemical Adsorption, types of adsorption isotherms . Langmuir's adsorption isotherm (Postulates and derivation expected). B.E.T. equation for multilayer adsorption, (derivation not expected). Determination of surface area of an adsorbent using B.E.T. equation.	
	4.2 COLLOIDAL STATE	9L
	4.2.1 **Introduction to colloids** - Emulsions, Gels and Sols	
	4.2.2 **Electrical Properties** : Origin of charges on colloidal particles, Concept of electrical double layer, zeta potential, Helmholtz and Stern model. Electro-kinetic phenomena - Electrophoresis, Electro-osmosis,	

	Streaming potential, Sedimentation potential; Donnan Membrane Equilibrium.	
	4.2.3 **Colloidal electrolytes :** Introduction, micelle formation,	
	4.2.4 **Surfactants:** Classification and applications of surfactants in detergents and food industry.	

Reference Books :

1. Physical Chemistry, Ira Levine, 5th Edition, 2002 Tata McGraw Hill Publishing Co.Ltd.
2. Physical Chemistry, P.C. Rakshit, 6th Edition, 2001, Sarat Book Distributors, Kolkota.
3. Physical Chemistry, R.J. Silbey, & R.A. Alberty, 3rd edition , John Wiley & Sons, Inc [part 1]
4. Physical Chemistry, G. Castellan, 3rd edition, 5th Reprint, 1995 Narosa Publishing House.
5. Modern Electrochemistry, J.O.M Bockris & A.K.N. Reddy, Maria Gamboa – Aldeco 2nd Edition, 1st Indian reprint,2006 Springer 6. Fundamental of Molecular Spectroscopy, 4th Edn., Colin N Banwell and Elaine M McCash Tata McGraw Hill Publishing Co. Ltd. New Delhi, 2008. 7. Physical Chemistry, G.M. Barrow, 6th Edition, Tata McGraw Hill Publishing Co. Ltd. New Delhi.
8. The Elements of Physical Chemistry, P.W. Atkins, 2nd Edition, Oxford Universtity Press Oxford.
9. Physical Chemistry, G.K. Vemullapallie, 1997, Prentice Hall of India, Pvt.Ltd. New Delhi.
10. Principles of Physical Chemistry B.R. Puri, L.R. Sharma, M.S. Pathania, VISHAL PUBLISHING Company, 2008.
11. Textbook of Polymer Science, Fred W Bilmeyer, John Wiley & Sons (Asia) Ple. Ltd., Singapore, 2007.
12. Polymer Science, V.R. Gowariker, N.V. Viswanathan, Jayadev

T.Y.B.Sc Physical Chemistry Practical

SEMESTER V

PHYSICAL CHEMISTRY

COURSE CODE: USCHP01

CREDITS: 02

Non-Instrumental

Colligative properties

To determine the molecular weight of compound by Rast Method

Chemical Kinetics

To determine the order between $K_2S_2O_8$ and KI by fractional change method. **(six units and three units)**

Surface phenomena

To investigate the adsorption of acetic acid on activated charcoal and test the validity of Freundlich adsorption isotherm.

Instrumental

Potentiometry

To determine the solubility product and solubility of AgCl potentiometrically using chemical cell.

Conductometry To determine the velocity constant of alkaline hydrolysis of ethyl acetate by conductometric method. **pH-metry**

To determine acidic and basic dissociation constants of amino acid and hence to calculate isoelectric point.

Reference books

1. Practical Physical Chemistry 3rd edition A.M.James and F.E. Prichard , Longman publication

2. Experiments in Physical Chemistry R.C. Das and B. Behra, Tata Mc Graw Hill

3. Advanced Practical Physical Chemistry J.B.Yadav, Goel Publishing House

4. Advanced Experimental Chemistry. Vol-I J.N.Gurtu and R Kapoor, S.Chand and Co.

5. Experimental Physical Chemistry By V.D.Athawale.

6. Senior Practical Physical Chemistry By: B. D. Khosla, V. C. Garg and A. Gulati, R Chand and Co.. 2011

SEMESTER VI

PHYSICAL CHEMISTRY

COURSE CODE: USCH601 **CREDITS: 02**

LECTURES: 60

UNIT I	1.1 ELECTROCHEMISTRY	7L
	1.1.1 **Activity and Activity Coefficient:** Lewis concept, ionic strength, Mean ionic activity and mean ionic activity coefficient of an electrolyte, expression for activities of electrolytes. Debye-Huckel limiting law (No derivation).	
	1.1.2 **Classification of cells:** Chemical cells and Concentration cells. Chemical cells with and without transference, Electrode Concentration cells, Electrolyte concentration cells with and without transference (derivations are expected),	
	1.2 APPLIED ELECTROCHEMISTRY	8L
	1.2.1 **Polarization**: concentration polarization and it's elimination	
	1.2.2 **Decomposition Potential and Overvoltage** : Introduction, experimental determination of decomposition potential, factors affecting decomposition potential. Tafel's equation for hydrogen overvoltage, experimental determination of over –voltage	
	2.0 POLYMERS	
UNIT II		15L
	2.1 **Basic terms :** macromolecule, monomer, repeat unit, degree of polymerization.	
	2.2. **Classification of polymers:** Classification based on source, structure, thermal response and physical properties.	
	2.3. **Molar masses of polymers:** Number average, Weight average, Viscosity average molar mass, Monodispersity and Polydispersity	
	2.4. **Method of determining molar masses of polymers :** Viscosity method using Ostwald Viscometer. (derivation expected)	
	2.5. **Light Emitting Polymers :** Introduction, Characteristics, Method of preparation and applications.	
	2.6. **Antioxidants and Stabilizers :** Antioxidants , Ultraviolet stabilizers, Colourants, Antistatic agents and Curing agents.	
UNIT III	3.1 BASICS OF QUANTUM CHEMISTRY 3.1.1 **Classical mechanics**: Introduction, limitations of classical mechanics, Black body radiation, photoelectric effect, Compton effect.	10 L

	3.1.2 **Quantum mechanics :** Introduction, Planck's theory of quantization, wave particle duality, de –Broglie's equation, Heisenberg's uncertainty principle. 3.1.3 **Progressive and standing waves-** Introduction, boundary conditions, Schrodinger's time independent wave equation (No derivation expected), interpretation and properties of wave function. 3.1.4 **Quantum mechanics** : State function and its significance, Concept of operators - definition, addition, subtraction and multiplication of operators, commutative and non - commutative operators, linear operator, Hamiltonian operator, Eigen function and Eigen value.	
	3.2 RENEWABLE ENERGY RESOURCES	5L
	3.2.1. **Renewable energy resources** : Introduction.	
	3.2.2 **Solar energy**: Solar cells, Photovoltaic effect, Differences between conductors,semiconductors ,insulators and its band gap, Semiconductors as solar energy converters, Silicon solar cell	
	3.2.3. **Hydrogen :** Fuel of the future, production of hydrogen by direct electrolysis of water, advantages of hydrogen as a universal energy medium.	
UNIT IV	4.1 NMR -NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY	7L
	4.1.1. Principle : Nuclear spin, magnetic moment, nuclear 'g' factor, energy levels, Larmor precession, Relaxation processes in NMR (spin -spin relaxation and spin - lattice relaxation). **4.1.2. Instrumentation**: NMR Spectrometer	
	4.2 ELECTRON SPIN RESONANCE SPECTROSCOPY	
	4.2.1. Principle: fundamental equation, g-value -dimensionless constant or electron g-factor, hyperfine splitting. **4.2.2. Instrumentation**: ESR spectrometer, ESR spectrum of hydrogen and deuterium.	8L

Note : Numericals and Word Problems are Expected from All Units

Reference Books :

1. Physical Chemistry, Ira Levine, 5th Edition, 2002 Tata McGraw Hill Publishing Co.Ltd.

2. Physical Chemistry, P.C. Rakshit, 6th Edition, 2001, Sarat Book Distributors, Kolkota.

3. Physical Chemistry, R.J. Silbey, & R.A. Alberty, 3rd edition , John Wiley & Sons, Inc [part 1]

4. Physical Chemistry, G. Castellan, 3rd edition, 5th Reprint, 1995 Narosa Publishing House.

5. Modern Electrochemistry, J.O.M Bockris & A.K.N. Reddy, Maria Gamboa – Aldeco 2nd Edition, 1st Indian reprint 2006 Springer

6. Fundamental of Molecular Spectroscopy, 4th Edn., Colin N Banwell and Elaine M McCash Tata McGraw Hill Publishing Co. Ltd. New Delhi, 2008.

7. Physical Chemistry, G.M. Barrow, 6th Edition, Tata McGraw Hill Publishing Co. Ltd. New Delhi.

8. The Elements of Physical Chemistry, P.W. Atkins, 2nd Edition, Oxford Universtity Press Oxford.

9. Physical Chemistry, G.K. Vemullapallie, 1997, Prentice Hall of India, Pvt.Ltd. New Delhi.

10. Principles of Physical Chemistry B.R. Puri, L.R. Sharma, M.S. Pathania, VISHAL PUBLISHING Company, 2008.

11. Textbook of Polymer Science, Fred W Bilmeyer, John Wiley & Sons (Asia) Ple. Ltd., Singapore, 2007.

12. Polymer Science, V.R. Gowariker, N.V. Viswanathan, Jayadev Sreedhar, New Age International (P) Ltd., Publishers, 2005.

13. Essentials of Nuclear Chemistry, Arnikar, Hari Jeevan , New Age International (P) Ltd., Publishers, 2011..

14. Chemical Kinetics,K. Laidler, Pearson Education India, 1987.

T.Y.B.Sc Physical Chemistry Practical

SEMESTER VI

PHYSICAL CHEMISTRY

COURSE CODE: USCHP02 **CREDITS: 02**

Non-Instrumental

Chemical Kinetics

To interpret the order of reaction graphically from the given experimental data and calculate the specific rate constant.

(No fractional order)

Viscosity

To determine the molecular weight of high polymer polyvinyl alcohol (PVA) by viscosity measurement.

Instrumental

Potentiometry

To determine the amount of iodide, bromide and chloride in the mixture by potentiometric titration with silver nitrate.

To determine the number of electrons in the redox reaction between ferrous ammonium sulphate and cerric sulphate potentiometrically.

Conductometry

To titrate a mixture of weak acid and strong acid against strong base and estimate the amount of each acid in the mixture conductometrically.

Colorimetry

To estimate the amount of Fe(III) in the complex formation with salicylic acid by Static Method.

Reference books

1. Practical Physical Chemistry 3rd edition A.M.James and F.E. Prichard , Longman publication

2. Experiments in Physical Chemistry R.C. Das and B. Behra, Tata Mc Graw Hill

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