TECHNO INDIA UNIVERSITY
WESTBENGAL

EM 4, Sector V, Salt Lake, Kolkata-700091, West Bengal, India
Phone: +91 9836544416/17/18/19, Fax: +91 33 2357 1097

2-Year Master of Science (M.Sc.) Curriculum and Syllabus for Chemistry

First Semester

Course Code	Course Title	Contact Hrs. / Week			Credit
		L	T	P	
Theory					
TIU-PEN-T101	Career Advancement Skill Development	2	1	0	3
TIU-PCH-T101	Physical Chemistry	3	1	0	3
TIU-PCH-T103	Organic Chemistry	3	1	0	3
TIU-PCH-T105	Inorganic Chemistry	3	1	0	3
TIU-PCH-T107	Analytical Chemistry	3	1	0	3
Practical					
TIU-PCH-L101	Physical Chemistry Lab	0	0	3	2
TIU-PPH-L113	Computer application with C programming	0	0	3	2
Sessional					
TIU-PES-S199	Entrepreneurship Skill Development	0	0	2	2
	Total	14	5	8	**21**

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Semester-I

Physical Chemistry
TIU-PCH-T101

L-T-P: 3-1-0 **Credit: 3**

Module 1

Thermodynamics

A. Classical Thermodynamics

Brief review on basic concept of thermodynamics. Partial molar quantities and their significances. Third law of thermodynamics: Nernst heat theorem, variation of entropy with temperature, determination of absolute entropy of liquid and gases, residual entropy.

B. Statistical Thermodynamics

Thermodynamic probability and entropy, Maxwell-Boltzmann distribution law; Bose-Einstein and Fermi-Dirac statistics, Partition function: rotational, translational, vibrational and electronic partition functions of diatomic molecules, Relation between partition functions with different thermodynamic functions, Entropy of a perfect gas: Gibb's paradox and Sackur-Tetrode equation.

Module 2

Chemical Kinetics

Brief review on basic chemical kinetics, Composite reactions-types of composite mechanisms, rate equations for composite mechanisms, simultaneous and consecutive reactions, steady state treatment, rate-determining steps, microscopic reversibility and detailed balance, dynamic chain (H_2-Br_2 reaction, decomposition of ethane and acetaldehyde) and oscillatory reactions (Belousov-Zhabotinskii reaction), branching chain: H_2-O_2 reaction.

Module 3

Nuclear Chemistry

Elements of radiation chemistry, General characteristics of radioactive decay, decay kinetics, parent daughter decay growth relationships, artificial radioactivity, Classification of nuclides, Nuclear stability, Nuclear isomerism and internal conversion, Interaction of nuclear radiation with matter, charged particles, neutrons and gamma rays, Unit of radiation absorption, radiation dosimetry, Types of nuclear reaction-fission and fusion, Conservation in nuclear reaction: linear momentum and mass- energy, Bohr's compound nucleus theory of nuclear reaction.

Recommended books

1. P.W. Atkins, Physical Chemistry, 8th Editions, Oxford University Press, New York
2. I.N. Levine, Physical Chemistry, 5th Edition, Tata McGraw Hill Publication Co, Ltd, New Delhi
3. H.J. Arnikar, Essentials of Nuclear Chemistry, 4th Edition, Wiley-Eastern Ltd, New Delhi.

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4. G.W. Castellan, Physical Chemistry, 3rd Edition, Narosa Publishing House

Organic Chemistry
TIU-PCH-T103

L-T-P: 3-1-0 **Credit: 3**

Module 1
Aromaticity
Benzenoid and nonbenzenoid systems, antiaromaticity, homoaromaticity, alternant and non-alternant hydrocarbons

Module 2
Structure-reactivity relationship: A quantitative approach
Linear free energy relations: Hammett equation, Hammett's σ_x and ρ values and their physical significance through-conjugation; deviations from straight line plots; steric effects: Taft equation; solvent effects: Grunwald-Winstein equation

Module 3
A. Nucleophilic Substitutions at Saturated Carbon
Mechanism and Stereochemistry of S_N1, S_N2, S_N^i and S_N2 reactions. Reactivity: The effect of substrate structure, attacking nucleophile, leaving group and reaction medium. Phase transfer catalysis and ultrasound, Ambient nucleophiles: Regioselectivity. Competition between S_N1 and S_N2 mechanisms

B. Protection and Deprotection of Functional Groups
Protection of NH_2 group, OH group, diols, carbonyl groups, carboxyl groups, double bonds and triple bonds

C. Heterocycles
Nomenclature of heterocyclic compounds, Synthesis, reactivity and uses of the following heterocyclic compounds [containing one hetero-atom] and their derivatives: furan, thiophene, pyrrole, pyridine & indole.

Recommended books

1. P. S. Kalsi, Organic reaction and their Mechanisms, 1st Edition, (1996), New Age International Publication, New Delhi.
2. T. H. Lowry, K.S. Richardson, Mechanism and theory in Organic Chemistry, 3rd Edition (1998), Addison-Wesley Longman Inc. (IS Edition).
3. S. M. Mukherjee, S.P. Singh, Reaction Mechanism in Organic Chemistry, 1st Edition, (1990), MacMillan Indian Ltd, New Delhi.
4. Peter Sykes, A guide book to Mechanism in Organic Chemistry, 6th Edition (1997), Orient Longman Ltd, New Delhi.

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5. R. T. Morrison, R.N. Boyd, Organic Chemistry, 6th Edition (2003), Prentice- Hall of India, New Delhi.
6. I. Fleming, Pericyclic Reactions, (1999), Oxford University Press, Oxford
7. S. M. Mukherjee and S.P. Singh, Pericyclic Reactions by MacMillan India Ltd.

Inorganic Chemistry
TIU-PCH-T105

L-T-P: 3-1-0 **Credit: 3**

Module 1

Chemical Bonding: LCAO-MO and VB treatments on H_2^+, H_2 ; application to homo- and hetero- nuclear diatomic molecules/ ions of second period elements, Importance of bond order, MO's of diatomic and polyatomic molecules BeH_2, H_2O, NH_3, CH_4.

Module 2

Metal-Ligand Bonding in Transition Metal Complexes: Crystal field splitting diagrams in complexes of low symmetry; Spectrochemical and Nephelauxetic series; thermodynamic and structural effects; site selection in spinels, Jahn-Teller distortions; experimental evidence for metal-ligand orbital overlap; ligand field theory, molecular orbital theory as applied to metal complexes, brief introduction to Angular Overlap Model.

Module 3

A. Electronic spectra of Transition Metal Complexes: Spectroscopic ground states; Orgel energy level and Tanabe-Sugano diagrams for transition metal complexes; Charge transfer spectra; electronic spectra of octahedral and tetrahedral Co(II) and Ni(II) complexes and calculation of ligand-field parameters.

B. Symmetry and Group Theory: Symmetry elements and operations, determination of point group of a molecule, reducible and irreducible representations, definitions of classes and character, statement of Grand Orthogonality Theorem, construction of character table, reduction formula, direct product representation and its uses, symmetry of normal modes, normal mode analysis, selection rules for IR and Raman transitions.

Recommended books

1. D.F. Shriver, P.W. Atkins, Inorganic Chemistry, 3rd Edition (1999) ELBS, London
2. B. Douglas, D. McDaniel, J. Alexander, Concepts and Models of Inorganic Chemistry, 3rd Edition (2001), John Wiley and Sons, Inc., New York.

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3. F. A. Cotton, G. Wilkinson, Advanced Inorganic Chemistry, 6th Edition (1999), John Wiley & Sons, New York
4. James E. Huheey, Inorganic Chemistry, 4th Edition (1993) Addison-Wesley Pub. Co., New York
5. R.S. Drago, Physical Methods in Inorganic Chemistry, International Edition (1971), Affiliated east-west press, New Delhi.
6. Keith F Purcell, John C Kotz, Inorganic Chemistry, W.B. Saunders Company (1987), Hong Kong.
7. B. N. Figgis, Introduction to Ligand fields, Wiley Eastern Ltd., New Delhi (1976)
8. F. A. Cotton, Chemical Applications of Group Theory, 3rd Edition (1999), John Wiley & Sons, New York.

Analytical Chemistry
TIU-PCH-T107

L-T-P: 3-1-0 **Credit: 3**

Module 1
Analytical Statistics

Scope & objectives, Analytical chemistry and chemical analysis, Classification of analytical methods, Method selection, Sample processing, Steps in a quantitative analysis, Quantitative range (bispartite classification), Data organization, Analytical validations, Limit of detection and limit of quantitation, The tools of analytical chemistry and good lab practices. Analytical Chemometrics

Module 2
Treatment of Equilibria

Solvents and solutions, general treatment of equilibria in aqueous medium involving monoprotic weak acid and weak base, and salts of weak acids and weak bases. Activity and concentration, Effect of electrolytes on chemical equilibria, Calculation of pH, Constructing titration curves from charge balance and mass balance equations, Acidbase titrations and theory of pH indicators, Complexation equilibria and complexometric titrations, Redox equilibria and redox titration, Theory of redox indicators, Precipitation reaction and precipitation titrations and theory of adsorption indicators

Module 3
Environmental Chemistry and Analysis

Air Pollution: Air quality standards and norms (OSHA, NIOSH, CPCB and WBPCB), Monitoring and Determination of air pollutants: SO_x, NO_x, NH_3, hydrocarbons, VOC's, CO, SPM, RPM, $PM_{2.5}$, Indoor air pollutants, photochemical smog and acid rain, and Green house gas effect (concise)

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Water Pollution: Water-quality parameters and standards (CPCB and MoEF): physical and chemical parameters, Dissolved oxygen (DO), BOD, COD, Total organic carbon, Total nitrogen, Total sulfur, Total phosphorus, Chlorine, Heavy metals (Pb, As, Hg) and Pesticides

Waste water treatment and solid waste: Various types of waste water treatment: physical, chemical, aerobic and anaerobic (UASB) treatments, waste recycling, solid waste treatment and recycling

Environmental sampling, analysis, emission, and control: Sampling techniques (Air/water/soil) Environmental sample analysis by UV-Vis Spectrophotometer, GC, and HPLC, Emission: Fugitive emission, BTX analysis, Emission control equipments
Meteorology: Earth atmosphere, Wind-rose (Concise)

Recommended books

1. D. A. Skoog, Principles of Instrumental Analysis, 5th Edition (1998), Saunders College Publishing, Philadelphia, London.
2. D. A. Skoog, D.M. West, F.J. Holler, S.R. Crouch, Analytical Chemistry-An Introduction, 7th Edition, (2000), Saunders College Publishing, Philadelphia, London.
3. Nirmalendu Nath, Kakoli Upadhyay, Avinash Upadhyay, Biophysical Chemistry Principles and Techniques, Himalaya Publishing house, New Delhi.
4. J. H. Kennedy, Analytical Chemistry: Principles, 2nd Edition (1990), Saunders Holt, London.
5. G. W. Ewing, Instrumental Methods of Chemical Analysis, 5th Edition (1978), McGraw Hill Books Co, New York.
6. R. L. Pecsok, L. D. Shields, T. Cairns, and L.C. Mc William, Modern method of Chemical Analysis, 2nd Edition (1976), John Wiley, New York.
7. G. D. Christian, Analytical Chemistry, 5th Edition (1994), John Wiley & Sons, New York.
8. G. W. Vanloon, S.J. Duffer, Environmental Chemistry - A Global Perspective, Oxford University Press (2000).
9. F. W. Fifield and W. P. J. Hairens, Environmental Analytical Chemistry, 2nd Edition (2000), Black Well Science Ltd.
10. Colin Baird, Environmental Chemistry, W. H. Freeman and Company, New York (1995).
11. A. K. De, Environmental Chemistry, 4th Edition (2000), New Age International Private Ltd., New Delhi.
12. Peter O. Warner, Analysis of Air Pollutants, 1st Edition (1996), John Wiley, New York.
13. S. M. Khopkar, Environmental Pollution Analysis, 1st Edition (1993), Wiley Eastern Ltd., New Delhi.
14. S. K. Banerji, Environmental Chemistry, 1st Edition (1993), Prentice-Hall of India, New Delhi.

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Physical Chemistry Lab
TIU-PCH-L101

L-T-P: 0-0-3 **Credit: 2**

Experiment 1: Saponification of ethyl acetate by NaOH: determination of rate constant

Experiment 2: Determination of energy of activation of Saponification of ethyl acetate
Experiment 3: Determination of rate constant of acid catalyzed hydrolysis of sucrose by polarimetric method
Experiment 4: Verification of Lambert-Beer's law: Determination of concentration of unknown solution
Experiment 5: Determination of heat of solution of oxalic acid from its solubility at different temperature
Experiment 6: To construct the phase diagram of a three component system: Chloroform-acetic acid-water
Experiment 7: Conductometric study of the kinetics of Saponification of methyl/ethyl acetate
Experiment 8: Determination of equivalent conductance at infinite dilution of KCl at room temperature
Experiment 9: Determination of strengths of strong and weak acids in a mixture conductometrically
Experiment 10: Determination of CMC of a surfactant by conductometric method
Experiment 11: Potentiometric titration of a strong acid with strong base using quinhydrone electrode
Experiment 12: Spectrophotometric study on hydrogen bonded complexation
Experiment 13: Synthesis and characterization of different nano materials
Experiment 14: Determination of partial molal quantity