भारतीय प्रौद्योगिकी संस्थान भुवनेश्वर
INDIAN INSTITUTE OF TECHNOLOGY BHUBANESWAR

COURSE DETAILS FOR VARIOUS ACADEMIC PROGRAMME

Name of the Programme: ITEP-Chemistry

Core course for Chemistry Major/ Minor students.

Name of the School: Basic Sciences

1.	**Course Title:**	Basic Organic Chemistry
2.	**Subject Code:**	CY1L301
3.	**L: T: P:**	4-0-0
4.	**Credit:**	4
5.	**Semester No:**	I
6.	**Core/Elective/Breadth:**	Core
7.	**Contact Hours:**	56
8.	**Theory:**	Yes
9.	**(Autumn/ Spring):**	Autumn
10.	**Level:**	B.Sc.-B.Ed.
11.	**Pre- requisite:**	Chemistry at 10+2 level
12.	**Lab:**	None

13. Objective of Course:

The objective of this course is to introduce the basics of organic chemistry to the students and prepare the necessary background for advanced courses on organic chemistry.

14. Lecture -wise Break up

Sl. No.	Course Contents	Contact Hours/ No. of Lectures	No. of Tutorial / Practical
1	**Basic Stereochemistry** Stereochemistry: Different types of isomerism, Fischer projection and flying wedge formulae, Newman and Sawhorse projection, configuration, conformational analysis.	8	0
2	**Reactive intermediates and basics of organic reactions** Electronic displacements, dipole moment, organic acids and bases, homolytic and heterolytic fission, curly arrow rules,	6	0

	carbocations, carbanions, free radicals and carbenes.		
3	**Alkanes** Preparation: Wurtz reaction, Kolbe's synthesis, Corey-House synthesis, from Grignard reagent; Reactions.	4	0
4	**Alkenes** Preparation: cis-alkenes and trans alkenes. Reactions: Addition, hydration, ozonolysis, oxymecuration-demercuration, hydroboration-oxidation.	4	0
5	**Alkynes** Preparation: terminal and internal alkynes; Reactions: metal acetylides, Br_2 and alkaline $KMnO_4$, ozonolysis, oxidation, hydration, alkylation of terminal alkynes.	4	0
6	**Aromatic hydrocarbons and reactions of benzene derivatives** Aromaticity, Huckel rule, sigma and pi complexes, nitration, halogenations, sulphonation, mercuration and Friedel craft's reaction, mono-substitution and directive effects, reactivity of nitrobenzene, phenol and anilines.	10	0
7	**Alcohols** Preparations, properties and reactions.	4	0
8	**Aldehydes and Ketones** Structure, reactivity and preparation; Reactions: Nucleophilic addition, nucleophilic addition-elimination, condensation, substitution, oxidation and reduction reactions.	8	0
9	**Carboxylic acids and their derivatives** Preparation, physical properties and reactions of monocarboxylic acids; Preparation and reactions of acid chlorides, anhydrides, esters and amides; Acidic and alkaline hydrolysis of esters.	4	0
10	**Carbohydrates** Classification, biological importance, epimers, mutarotation, anomers, monosaccharides, configurations of glucose, Killiani-Fischer synthesis, osazone formation.	4	0
	Total	56	0

15. Suggested Books:

Sl. No.		Year of Publication / Reprint
1	Advanced organic chemistry: Reactions, mechanism and structure by Jerry March.	2006
2	Stereochemistry of Organic Compounds by D. Nasipuri	2012
3	Advanced Organic chemistry by F. A. Carey and R. J. Sundberg	2000
4	Organic Chemistry by Clayden, Greeves, Warren and Wothers	2012

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COURSE DETAILS FOR VARIOUS ACADEMIC PROGRAMME

Name of the Programme: ITEP-Chemistry

Core course for Chemistry Major/ Minor students.

Name of the School: Basic Sciences

1.	**Course Title:**	Organic Chemistry Lab-I
2.	**Subject Code:**	CY1P301
3.	**L: T: P:**	0-0-3
4.	**Credit:**	2
5.	**Semester No:**	I
6.	**Core/Elective/Breadth:**	Core
7.	**Contact Hours:**	42
8.	**Theory:**	None
9.	**(Autumn/ Spring):**	Autumn
10.	**Level:**	B.Sc.-B.Ed.
11.	**Pre- requisite:**	None
12.	**Lab:**	Yes

13. Objective of Course:

The objective of this course is to familiarize students about introductory organic laboratory experiments and analysis.

14. Lecture -wise Break up

Sl. No.	Course Contents	Contact Hours/ No. of Lectures	No. of Tutorial / Practical
1	**Separation of organic compounds by solubility differences (neutral, acidic, basic functional groups)**	3	1
2	**Extraction of caffeine from Tea**	3	1
3	**Filtration and recrystallization technique**	3	1
4	**Functional group identification by IR spectroscopy**	3	1
5	**Isolation of lycopene from tomato**	3	1

6	**Isolation of eugenol from clove**	3	1
7	**Estimation of acetic acid in commercial vinegar**	3	1
8	**Analysis by UV-Visible Spectroscopy**	3	1
9	**Acetylation of phenol/primary amine and melting point analysis**	3	1
10	**Isolation of D-limonene from orange peel**	3	1
11	**Diazo coupling reactions of aromatic amines**	3	1
12	**Condensation reactions**	3	1
	Mid semester and End semester Examination	6	
	Total	42	

15. Suggested Books:

Sl. No.		**Year of Publication / Reprint**
1	A text book of Practical Organic Chemistry by A. I. Vogel	1989
2	Handbook of Organic Analysis, Qualitative and Quantitative by M. T. Clarke	1975
3	An advanced course in practical chemistry by A. K. Nad, B. Mahapatra and A. Ghoshal	2011

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COURSE DETAILS FOR VARIOUS ACADEMIC PROGRAMME

Name of the Programme: ITEP-Chemistry

Core course for Chemistry Major students.

Name of the School: Basic Sciences

1.	**Course Title:**	Organic Reaction Mechanism
2.	**Subject Code:**	CY1L302
3.	**L: T: P:**	4-0-0
4.	**Credit:**	4
5.	**Semester No:**	II
6.	**Core/Elective/Breadth:**	Core
7.	**Contact Hours:**	56
8.	**Theory:**	Yes
9.	**(Autumn/ Spring):**	Spring
10.	**Level:**	B.Sc.-B.Ed.
11.	**Pre- requisite:**	Basic Organic Chemistry
12.	**Lab:**	None

13. Objective of Course:

The objective of this course is to make the students familiar with different types of organic reactions and their mechanisms in detail for practical applications in synthetic planning.

14. Lecture -wise Break up

Sl. No.	Course Contents	Contact Hours/ No. of Lectures	No. of Tutorial / Practical
1	**Substitution and Elimination Reactions** Nucleophilic substitution reactions: Mechanisms of S_N1, S_N2, S_N2', S_N1' and S_Ni; electrophilic substitution reactions (S_E1, S_E2, S_Ei); Elimination reactions: E1, E2, E1cb and Ei; reactivity, regioselectivity and stereoselectivity.	8	0
2	**Aromatic hydrocarbons and reactions of benzene derivatives**	8	0

	Benzene: aromaticity and stability; Electrophilic aromatic substitution: sigma and pi complexes, energy profile diagram, examples; Ipso substitution; Nucleophilic aromatic substitution: S_NAr, diazonium salts, aryne mechanism, Vicarious mechanism.		
3	**Nucleophilic addition to C=X (X = O, NR)** Addition/elimination reactions: Structure and reactivity, Burgi Dunitz Trajectory, Enamine, Mannich reaction. Reductive transformations: Umpolung, acetylide anions, organometallic reagents, Stereoselectivity: Cram's Rule, Felkin-Ahn and Zimmerman Traxler model. Claisen ester condensation, Dieckmann reaction, Michael reaction, Robinson annulation, Baylis-Hilmann reaction, Reformatsky reaction, McMurry coupling.	12	0
4	**Electrophilic and nucleophilic addition reaction to C=C, C≡C** Electrophilic addition reactions via halonium & carbocation intermediate, catalytic hydrogenation and Birch reduction, cis-addition and trans-addition, Markovnikov's rule, electrophilic addition to conjugated dienes.	8	0
5	**Oxidation and Reduction reactions** Mechanism and examples of oxidation-reduction; Oxidation: Cr(VI) based oxidation, hypervalent iodine reagent, Peroxo based reagents, $KMnO_4$, OsO_4; Reduction: hydride donors, Pd, Pt, Ni based reduction, Raney Nickel, Wilkinson's catalyst, Lindlar catalyst, Clemmensen reduction, Wolf-Kishner reduction, MPV reduction, Birch reduction.	10	0
6	**Pericyclic reactions** Mechanism, stereochemistry, regioselectivity of electrocyclic, cycloaddition, cycloreversion and Sigmatropic reactions; FMO approach, thermal and photochemical pathways, [1,3]- and [1,5]-H shifts and [3,3]-shifts with reference to Claisen and Cope rearrangements.	10	0
	Total	56	0

15. Suggested Books:

Sl. No.		Year of Publication / Reprint
1	A Guidebook to Mechanism in Organic Chemistry by Peter Sykes	2003
2	Organic Reactions And Their Mechanisms by P S Kalsi	2020
3	Advanced organic chemistry: Reactions, mechanism and structure by Jerry March.	2006
4	Stereochemistry of Organic Compounds by D. Nasipuri	2012
5	Advanced Organic chemistry by F. A. Carey and R. J. Sundberg	2000
6	Organic Chemistry by Clayden, Greeves, Warren and Wothers	2012

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Name of the Programme: ITEP-Chemistry

Core course for Chemistry Major/ Minor students.

Name of the School: Basic Sciences

1.	**Course Title:**	INTRODUCTION TO PHYSICAL CHEMISTRY
2.	**Subject Code:**	CY1L303
3.	**L: T: P:**	4-0-0
4.	**Credit:**	4
5.	**Semester No:**	II
6.	**Core/Elective/Breadth:**	Core
7.	**Contact Hours:**	56
8.	**Theory:**	Yes
9.	**(Autumn/ Spring):**	Spring
10.	**Level:**	B.Sc.-B.Ed.
11.	**Pre- requisite:**	Nil
12.	**Lab:**	No

13. Objective of Course:

The objective of this course is to make students familiar with the principle of basic physical chemistry.

14. Lecture -wise Break up

Sl. No.	Course Contents	Contact Hours/ No. of Lectures	No. of Tutorial / Practical
1	**Kinetic Theory of Gases** a. Concept of pressure and temperature; Collision of gas molecules; mean free path; Frequency of binary collisions (similar and different molecules); Rate of effusion	14	

	b. Nature of distribution of velocities, Maxwell's distribution of speed and kinetic energy; Average velocity, root mean square velocity and most probable velocity; Principle of equipartition of energy and its application to calculate molar heat capacity of gases c. Deviation of gases from ideal behavior; compressibility factor; Boyle temperature; van der Waals equation and its features; Intermolecular forces		
2	**Properties of Liquids and Surface phenomenon** a. Surface tension and energy: Surface tension, Surface energy, Excess pressure, Capillary rise, Work of cohesion and adhesion, Spreading of liquid over other surface; Effect of Temperature. b. Viscosity: Fluid flow, viscosity coefficient, Poiseuille's equation, effect of temperature, Reynolds number, determination of viscosity coefficient. c. Adsorption: Physical and chemical adsorption; Freundlich and Langmuir adsorption isotherms; multilayer adsorption and BET theory; Gibbs adsorption isotherm and surface excess; Heterogenous catalysis. d. Colloids: Lyophobic and lyophilic sols, Origin of charge and stability of lyophobic colloids, coagulation and Schultz-Hardy rule, Zeta potential and Stern double layer, Tyndall effect; Electrokinetic phenomena; Micelle formation.	14	
3	**Solids** Forms of solids, crystal systems, unit cells, Bravais lattice types, Symmetry elements; Law of rational indices; Miller indices of different planes and interplanar distance, Bragg's law; Structures of NaCl, KCl and CsCl; Defects in crystals; Glasses and liquid crystals.	8	
4	**Introduction to Thermodynamics-1 and Chemical Kinetics** a. System, surroundings, Isolated, closed and open systems, Thermodynamic equilibrium, extensive and intensive properties, State variables, Isothermal, adiabatic and isobaric processes, Reversible and Irreversible Process, Equations of State, Zeroth law. b. Work, Heat, Internal Energy, Heat Capacity, Enthalpy, First law and Second law. c. Reaction Rates, Rate Laws, order and molecularity, determine rate law experimentally, Rate equation and half-life period of First, second, nth order reactions, Pseudo first order reactions, Opposing reactions, consecutive reactions and parallel reactions	20	

	d. Arrhenius equation and activation energy, Collision theory, Lindemann theory of unimolecular reaction; Transition State theory (classical treatment) e. Kinetic isotope effect, Catalysis, Enzyme kinetics, Chain reaction, Photochemical reactions, Oscillating reactions.		
	Total	56	

15. Suggested Books:

Sl. No.		**Year of Publication / Reprint**
1	Principles for physical Chemistry- Puri, Sharma and Pathania	
2	Physical chemistry – Bahl and Tuli	
3	Physical chemistry-S. Glasstone	
4	Physical chemistry (vol I to V) K. L. Kapoor	
5	Physical chemistry-Soni, Dharmarah and Dash	
6	Physical chemistry-P.C. Rakhi	
7	Thermodynamics for chemists- S. Glasstone	
8	Electrochemistry- S. Glasstone	
9	Physical chemistry- Atkins	
10	Basic physical chemistry- G. M. Barrow	
11	Physical chemistry (solved Problems) Dogra and Dogra	
12	Problems in Physical chemistry- Pahari and Pahari	

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COURSE DETAILS FOR VARIOUS ACADEMIC PROGRAMME

Name of the Programme: ITEP-Chemistry

Core course for Chemistry Major/ Minor students.

Name of the School: Basic Sciences

1.	**Course Title:**	PHYSICAL CHEMISTRY LABORATORY
2.	**Subject Code:**	CY1P302
3.	**L: T: P:**	0-0-3
4.	**Credit:**	2
5.	**Semester No:**	II
6.	**Core/Elective/Breadth:**	Core
7.	**Contact Hours:**	42
8.	**Theory:**	No
9.	**(Autumn/ Spring):**	Spring
10.	**Level:**	B.Sc.-B.Ed.
11.	**Pre- requisite:**	Nil
12.	**Lab:**	Yes

13. Objective of Course:

The objective of this course is to familiarize students about the physical chemistry laboratory experiments and analysis.

14. Lecture -wise Break up

Sl. No.	Course Contents	Contact Hours/ No. of Lectures	No. of Tutorial / Practical
1	**PHYSICAL CHEMISTRY LABORATORY** a) Determination of the **surface tension** and parachor of a homologous series b) Measurement of the coefficient of **viscosity** of ethanol & ethanol – water system	36	12

	c) Determination of Critical Micellar Concentration (C.M.C.) of a surface-active agent **conductometrically** d) Studies on **pH metric titration** of weak base with strong acid e) Estimation of sulphate ion in tap water by **nepheloturbidimetric analysis** f) **Spectrophotometric determination** of acid dissociation constant (pKa) of methyl red, an acid base indicator g) Determination of **solubility and solubility product** of a sparingly soluble salt at room temperature by conductometric method h) **Potentiometric titration** of a given sodium carbonate solution with aqueous hydrochloric acid solution i) Determination of the **rate constant of the alkaline hydrolysis of ethyl acetate** at two different temperatures j) To determine **spectrophotometrically** the concentration of an unknown reducing carbohydrate solution using DNS method k) **Phase diagram** for a Binary system (phenol +Water) The radius of molecule from **viscosity measurements**		
	Mid Semester and End semester Examination	06	
	Total	42	12

15. Suggested Books:

Sl. No.		Year of Publication / Reprint
1	Maity S. and Ghosh N. Physical Chemistry Practical, New Central Book Agency (P) Ltd.	
2	Nad A. K.; Mahapatra B. and Ghoshal A., An advanced course in practical chemistry, New Central Book Agency (P) Ltd.	

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Name of the Programme: ITEP-Chemistry

Core course for Chemistry Major students.

Name of the School: Basic Sciences

1.	**Course Title:**	THERMODYNAMICS AND COLLIGATIVE PROPERTIES
2.	**Subject Code:**	CY2L301
3.	**L: T: P:**	4-0-0
4.	**Credit:**	4
5.	**Semester No:**	III
6.	**Core/Elective/Breadth:**	Core
7.	**Contact Hours:**	56
8.	**Theory:**	Yes
9.	**(Autumn/ Spring):**	Autumn
10.	**Level:**	B.Sc.-B.Ed.
11.	**Pre- requisite:**	Introduction to Physical Chemistry
12.	**Lab:**	No

13. **Objective of Course:**

The objective of this course is to make students familiar with the basic principles of physical chemistry.

14. Lecture -wise Break up

1	**Thermodynamics-II** a. First law, Isothermal and adiabatic expansion of gas, Joule-Thompson effect. b. Internal energy and enthalpy of a reaction, Exothermic and endothermic reaction, Kirchhoff equation, Hess's law, Bond energy. c. Limitation of first law, Cyclic process, Carnot Cycle, Heat Engines, Different statements of the Second Law, Concept of entropy, entropy change of gas, free energy and	26	

	dependence on T and P, Gibbs-Helmholtz equation, Maxwell relations. d. Chemical Potentials, Chemical Potential of Mixtures, Clausius-Clapeyron equation, Nernst heat theorem, Third law, absolute entropy.		
2	**Phase Equilibria** a. Phases, components and degrees of freedom of a system, criteria of phase equilibrium; Gibbs Phase Rule. b. Derivation of Clausius – Clapeyron equation and its importance in phase equilibria; Phase diagrams of one-component systems (water, CO_2 and sulphur) and two component systems involving eutectics, congruent and incongruent melting points (lead-silver, $FeCl_3$-H_2O and Na-K only), Solid-liquid phase diagram; Eutectic mixture.	15	
3	**Solutions and Colligative properties** Vapour pressure of solution and temperature dependence; Ideal Solutions, Non Ideal Solutions, Raoult's law, Free energy of mixing, Lowering of vapour pressure, elevation of boiling point, depression of freezing point, osmotic pressure, Abnormal colligative properties.	15	
	Total	56	

15. Suggested Books:

Sl. No.		Year of Publication / Reprint
1	Principles for physical Chemistry- Puri, Sharma and Pathania	
2	Physical chemistry – Bahl and Tuli	
3	Physical chemistry-S. Glasstone	
4	Physical chemistry (vol I to V) K. L. Kapoor	
5	Physical chemistry-Soni, Dharmarah and Dash	
6	Physical chemistry-P.C. Rakhi	
7	Thermodynamics for chemists- S. Glasstone	
8	Electrochemistry- S. Glasstone	
9	Physical chemistry- Atkins	
10	Basic physical chemistry- G. M. Barrow	
11	Physical chemistry (solved Problems) Dogra and Dogra	
12	Problems in Physical chemistry- Pahari and Pahari	

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COURSE DETAILS FOR VARIOUS ACADEMIC PROGRAMME

Name of the Programme: ITEP-Chemistry

Core course for Chemistry Major students.

Name of the School: Basic Sciences

1.	**Course Title:**	Organic Spectroscopy
2.	**Subject Code:**	CY2L302
3.	**L: T: P:**	4-0-0
4.	**Credit:**	4
5.	**Semester No:**	III
6.	**Core/Elective/Breadth:**	Core
7.	**Contact Hours:**	56
8.	**Theory:**	Yes
9.	**(Autumn/ Spring):**	Autumn
10.	**Level:**	B.Sc.-B.Ed.
11.	**Pre- requisite:**	Basic Organic Chemistry
12.	**Lab:**	None

13. Objective of Course:

The objective of this course is to make the students familiar with different spectroscopic techniques used for organic compounds analysis and reaction monitoring.

14. Lecture -wise Break up

Sl. No.	Course Contents	Contact Hours/ No. of Lectures	No. of Tutorial / Practical
1	**UV Spectroscopy** Introduction, types of electronic transitions and allowed/forbidden transitions, chromophores and auxochromes, Bathochromic and Hypsochromic shifts, intensity of absorptions (Hyper-/Hypochromic effects).	4	0
2	**Fluorescence spectroscopy** Introduction, instrumentation, fluorophores, spectral and Time-Resolved Fluorescence, solvent and environmental	3	0

	effects on Fluorescence, Fluorescence Quenching, Fluorescence Sensing.		
3	**Circular Dichroism** Optical rotation, optical rotatory dispersion, Cotton effect, origin of CD, examples of CD spectroscopy, applications of CD spectroscopy.	3	0
4	**Infra-Red Spectroscopy** Electromagnetic spectrum, origin and applications of IR light, instrumentation, Hooke's Law and Dipole Moment, Functional group identification, influence of electronic parameters on the peak position, hydrogen-bonding effects, solvent effects.	8	0
5	**Mass Spectrometry** Different instrumentation and ionization techniques: EI, CI, FAB, ESI, MALDI etc. Isotope distribution calculation, intensity calculation, nitrogen rule; Fragmentation: alkane, alkene, aryl alkane, ether, amine, alcohol, sulfide, McLafferty rearrangement, ketone, aldehyde, amino acids.	12	0
6	**Nuclear Magnetic Resonance Spectroscopy** Fundamentals of NMR: NMR sensitivity, magnetogyric ratio, relative abundance and I value, NMR Scale, integration, chemical shift, magnetic anisotropy, coupling constant, satellite peak, splitting patterns, spin system and magnetic equivalence, ^{13}C NMR, other nuclei	18	0
7	**X-Ray Diffraction** Diffraction geometry: Bragg's law, diffraction Intensity: structure factor function; powder diffraction and crystal structure determination; small-angle X-ray scattering.	8	0
	Total	56	0

15. Suggested Books:

Sl. No.		Year of Publication / Reprint
1	Introduction to Spectroscopy by Donald L. Pavia, Gary M. Lampman, George S. Kriz, James R. Vyvyan	2008
2	Spectrometric Identification of Organic Compounds by Robert M. Silverstein, Francis X. Webster, David J. Kiemle, David L. Bryce	2014
3	Fundamentals of Molecular Spectroscopy by Colin N. Banwell	2017
4	NMR Spectroscopy: Basic Principles, Concepts, and Applications in Chemistry by Harald Gunther	2013
5	Principles of Fluorescence Spectroscopy by J. R. Lakowicz	2010
6	Foundations of Crystallography with Computer Applications by Maureen M. Julian	2015

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Name of the Programme: ITEP-Chemistry

Core course for Chemistry Major/ Minor students.

Name of the School: Basic Sciences

1.	**Course Title:**	Basic Inorganic Chemistry
2.	**Subject Code:**	CY2L303
3.	**L: T: P:**	4-0-0
4.	**Credit:**	4
5.	**Semester No:**	III
6.	**Core/Elective/Breadth:**	Core
7.	**Contact Hours:**	56
8.	**Theory:**	Yes
9.	**(Autumn/ Spring):**	Autumn
10.	**Level:**	B.Sc.-B.Ed.
11.	**Pre- requisite:**	Science background at 10+2 level
12.	**Lab:**	None

13. Objective of Course:

The objective of this course is to introduce the basics of inorganic chemistry starting from different model for the atomic structure including Bohr's Model, Schrödinger's wave equation, quantum numbers, and principles governing electron configurations. The periodic properties will allow the students to rationalize various aspects of periodic trends such as atomic and ionic radii, ionization potential, electron affinity, and electronegativity, henceforth, their applications. Introduction to various acid-base concept and radioactivity will build a strong foundation for the general concepts of inorganic chemistry.

14. Lecture -wise Break up

Sl. No.	Course Contents	Contact Hours/ No. of Lectures	No. of Tutorial / Practical
1	**Atomic structure** Bohr's Model and its limitations, atomic spectrum of hydrogen. Schrödinger's wave equation, significance of ψ and ψ^2, radial and angular wave function for hydrogen atom, radial probability distribution curve, shapes s, p, d, and f orbitals. Introduction to quantum numbers, Aufbau principle and its limitations, Pauli's exclusion principle, Hund's rule,	16 Lectures	None

	electronic configurations of atoms.		
2	**Periodic Properties** Modern IUPAC periodic table and its characteristics. Atomic and ionic radii, ionization potential, electron affinity, and electronegativity and their applications; periodic and group-wise variation of above properties in respect of s- and p-block elements. Effective nuclear charge, Slater's rule, Inert pair effect, Lanthanide contraction.	14 Lectures	0
3	**Acid-Base Chemistry** Arrhenius concept, Acid-base indicators. Bronsted-Lowry concept, Lux-Flood concept, strength of acids and pH. Lewis's concept, HSAB principle and its applications. Applications of acid-base chemistry, utilizing acid-base chemistry. Chemistry in both aqueous and non-aqueous solvents, non-aqueous solvents.	16 Lectures	0
4	**Radioactivity** Nuclear stability, n/p ratio and modes of decay, nuclear binding energy. Nuclear models, Meson exchange theory, nuclear quantum number and magic numbers, nuclear fission and fusion. Applications of isotopes in biology and chemistry. Hazards associated with radioactivity and the corresponding safety precautions and exploring the management of nuclear waste.	10 Lectures	0
	Total	56 Lectures	0

15. Suggested Books:

Sl. No.		**Year of Publication / Reprint**
1	Advanced Inorganic Chemistry by Cotton and Wilkinson	1999
2	Essential Trends in Inorganic Chemistry by D. M. P. Mingos	1998
3	Inorganic chemistry- Principles of structure and reactivity by Huheey	2006
4	Inorganic Chemistry by Catherine Housecroft and Alan Sharpe	2012
5	Inorganic Chemistry by Shriver and Atkins	2010
6	Chemistry of the Elements by Greenwood and Earnshaw	1997

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Name of the Programme: ITEP-Chemistry

Core course for Chemistry Major/ Minor students.

Name of the School: Basic Sciences

1.	**Course Title:**	Inorganic Chemistry Lab-I
2.	**Subject Code:**	CY2P301
3.	**L: T: P:**	0-0-3
4.	**Credit:**	2
5.	**Semester No:**	III
6.	**Core/Elective/Breadth:**	Core
7.	**Contact Hours:**	42
8.	**Theory:**	No
9.	**(Autumn/ Spring):**	Autumn
10.	**Level:**	B.Sc.-B.Ed.
11.	**Pre- requisite:**	None
12.	**Lab:**	Yes

13. Objective of Course:

To develop practical laboratory skills and gain hands-on experience in various quantitative and qualitative chemical analysis techniques for the accurate estimation and separation of specific ions and compounds in diverse chemical mixtures. These experiments aim to develop students' competence in chemical analysis, equipping them with essential laboratory skills for both academic and practical applications in chemistry and related fields.

14. Lecture -wise Break up

Sl. No.	Course Contents	Contact Hours/ No. of Lectures	No. of Tutorial / Practical
1	Estimation of Fe(III) and Cu(II) in a mixture by dichromatometry	3	1
2	Estimation of Mg(II) and Zn(II) in a mixture by complexometry (EDTA)	3	1
3	Estimation of Ca^{2+} using $KMnO_4$ solution	3	1
4	Estimation of hardness of water by EDTA/Mg^{2+} estimation by EDTA	3	1

5	Estimation of sulphate ions in tap water by Nepheloturbidimetric analysis	3	1
6	Estimation of carbonate and hydroxide present together in mixture	3	1
7	Estimation of total hardnesss of water samples	3	1
8	Estimation of available chlorine in bleaching powder using iodometry	3	1
9	Estimation of available oxygen in pyrolusite using permanganometry	3	1
10	Estimation of phosphoric acid in soft drinks	3	1
11	Preparation of Mohr's salt	3	1
12	Paper Chromatographic separation of Ni (II) and Co(II); Cu(II) and Cd (II)	3	1
	Mid semester and end semester examination	6	0
	Total	42	12

15. Suggested Books:

Sl. No.		**Year of Publication / Reprint**
1	Vogel's Qualitative Inorganic Analysis	2012
2	Vogel's Textbook of Quantitative Chemical Analysis	2009

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COURSE DETAILS FOR VARIOUS ACADEMIC PROGRAMME

Name of the Programme: ITEP-Chemistry

Core course for Chemistry Major students.

Name of the School: Basic Sciences

1.	**Course Title:**	CHEMICAL EQUILIBRIA AND ELECTROCHEMISTRY
2.	**Subject Code:**	CY2L304
3.	**L: T: P:**	4-0-0
4.	**Credit:**	4
5.	**Semester No:**	IV
6.	**Core/Elective/Breadth:**	Core
7.	**Contact Hours:**	56
8.	**Theory:**	Yes
9.	**(Autumn/ Spring):**	Spring
10.	**Level:**	B.Sc.-B.Ed.
11.	**Pre- requisite:**	Thermodynamics and Colligative Properties
12.	**Lab:**	Nil

13. **Objective of Course:**

The objective of this course is to provide the depth about the physical chemistry of equilibrium and electrochemistry.

14. Lecture -wise Break up

Sl. No.	Course Contents	Contact Hours/ No. of Lectures	No. of Tutorial / Practical
1	**Chemical Equilibrium:** Spontaneous reaction, Equilibrium Constant (K_P, K_C and K_X) and free energy change, van't Hoff isotherm and isobar, dissociation constant, Le Chatelier's principle, partition coefficient and Nernst Distribution law.	12	

2	**Ionic Equilibria:** Dissociation of acid, base and water, pH, buffer solution, Hydrolysis of salt, Acid-base indicator, Solubility product, Chemical potential, activity and activity coefficients of ions in solution; Debye-Huckel limiting law.	12	
3	**Electrolytic Conductance** Strong and weak electrolytes, conductance, mobility, transport number, Kohlrausch's law, Ostwald's dilution law, Ionic activity and the Debye Huckel Theory, Ionic strength, Application of conductance measurement; Conductometric titrations (acid-base)	12	
4	**Electromotive force** a. Electrochemical cells, Galvanic Cell, The Nernst Equation, Standard electrode potentials, Calculation of thermodynamic properties, Determining equilibrium constant, Fuel cell and battery. b. Concentration cells with and without transference, liquid junction potential; Application of emf measurements; Potentiometric titrations (acid-base, redox, precipitation)	20	
	Total	56	

15. Suggested Books:

Sl. No.		Year of Publication / Reprint
1	Principles for physical Chemistry- Puri, Sharma and Pathania	
2	Physical chemistry – Bahl and Tuli	
3	Physical chemistry-S. Glasstone	
4	Physical chemistry (vol I to V) K. L. Kapoor	
5	Physical chemistry-Soni, Dharmarah and Dash	
6	Physical chemistry-P.C. Rakhi	
7	Thermodynamics for chemists- S. Glasstone	
8	Electrochemistry- S. Glasstone	
9	Physical chemistry- Atkins	
10	Basic physical chemistry- G. M. Barrow	
11	Physical chemistry (solved Problems) Dogra and Dogra	
12	Problems in Physical chemistry- Pahari and Pahari	

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COURSE DETAILS FOR VARIOUS ACADEMIC PROGRAMME

Name of the Programme: ITEP-Chemistry

Core course for Chemistry Major students.

Name of the School: Basic Sciences

1.	**Course Title:**	Main Group and Transition Metal Chemistry
2.	**Subject Code:**	CY2L305
3.	**L: T: P:**	4-0-0
4.	**Credit:**	4
5.	**Semester No:**	IV
6.	**Core/Elective/Breadth:**	Core
7.	**Contact Hours:**	56
8.	**Theory:**	Yes
9.	**(Autumn/ Spring):**	Spring
10.	**Level:**	B.Sc.-B.Ed.
11.	**Pre- requisite:**	Basic Inorganic Chemistry
12.	**Lab:**	None

13. **Objective of Course:**

This course will allow students to understand the molecular picture of molecules by the means of chronological study of different bonding theories. The knowledge of chemical bonding will be further utilized to understand various trends and anomalies of main group elements and their compounds. This course will also go in details to study the coordination chemistry with emphasis on transition metal elements. Detailed discussion on structure and bonding will be followed by using this knowledge to understand the unique properties of transition metal complexes such as color, reactivity and magnetic properties. This course will equip students with essential concepts at molecular level which are required to comprehend the properties of inorganic compounds.

14. Lecture -wise Break up

Sl. No.	Course Contents	Contact Hours/ No. of Lectures	No. of Tutorial / Practical
1	**Chemical bonding** Lewis structures, formal charges. Valence bond theory, Berry's pseudorotation, VSEPR theory, Brent's rule, hypervalency. Elementary MO theory, bond order, MO diagrams of homonuclear diatomics, heteronuclear diatomics	12 Lectures	0

	and triatomics.		
2	**Main group chemistry** Periodic trends in s- and p-block elements, diagonal relationship, allotropy and catenation. Polarisation of ions, Fajan's rules, radius ratio rules. Structure, bonding and properties of diborane, borazine, boron nitride, boric acid, borax, silicones, silicates, hydrazine, hydroxylamine, azide, phosphazines, polyphosphates, thio- and per-sulphates, interhalogen compounds, flourides and oxides of xenon.	18 Lectures	0
3	**Transition metal chemistry** Properties of transition metals (TM). Werner's theory, VB theory for TMs. Coordinate complexes, symmetry, chelating ligands. Crystal field theory: octahedral, tetrahedral, square planar geometries. Crystal field stabilization energy, pairing energy, high spin and low spin complexes, spin isomerism, spectrochemical series of ligands. Jahn-teller distortion. Electronic spectra, selection rules, Orgel diagrams. Irving-Williams series. Inorganic reaction mechanisms, substitution reactions in square planar complexes, *trans*-effect. Lability and inertness in octahedral complexes towards substitution reactions. Electron transfer reactions. L-S coupling and R-S ground state terms. Magnetic properties of TM complexes: effective magnetic moment, spin only moment for 3d metals, Orbital contribution to magnetic moment, spin-orbit coupling, quenching of orbital contribution.	26 Lectures	0
	Total	56 Lectures	0

15. Suggested Books:

Sl. No.		**Year of Publication / Reprint**
1	Coordination Chemistry by D. Banerjee	2009
2	Advanced Inorganic Chemistry by Cotton & Wilkinson	1999
3	Inorganic chemistry- Principles of structure and reactivity by . E. Huheey, E. A. Keiter, R. L. Keiter	2006
4	Inorganic Chemistry by Catherine Housecroft and Alan Sharpe	2018
5	Inorganic Chemistry by Shriver and Atkins	2010
6	The Chemistry of the p-block Elements, Anil. J. Elias	2018

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COURSE DETAILS FOR VARIOUS ACADEMIC PROGRAMME

Name of the Programme: ITEP-Chemistry

Core course for Chemistry Major/ Minor students.

Name of the School: Basic Sciences

1.	**Course Title:**	Industrial and Polymer Chemistry
2.	**Subject Code:**	CY2L306
3.	**L: T: P:**	4-0-0
4.	**Credit:**	4
5.	**Semester No:**	IV
6.	**Core/Elective/Breadth:**	Core
7.	**Contact Hours:**	56
8.	**Theory:**	Yes
9.	**(Autumn/ Spring):**	Spring
10.	**Level:**	B.Sc.-B.Ed.
11.	**Pre- requisite:**	Basic Organic chemistry and Basic Inorganic Chemistry
12.	**Lab:**	None

13. Objective of Course:

The objective of this course is to introduce the basics of organic chemistry to the students and prepare the necessary background for advanced courses on organic chemistry.

14. Lecture -wise Break up

Sl. No.	Course Contents	Contact Hours/ No. of Lectures	No. of Tutorial / Practical
1	**Chemical Technology** Distillation, solvent extraction, solid-liquid leaching and liquid-liquid extraction, separation by absorption and adsorption. Scaling up operations in chemical industry.	6	0
2	**Manufacturing of Inorganic Chemicals** Ammonia, hydrochloric acid, nitric acid, urea, sulphuric acid, caustic soda, common salt, borax, bleaching powder, sodium	8	0

	thiosulphate, hydrogen peroxide, potash alum, chrome alum, potassium dichromate and potassium permanganate.		
3	**Petroleum Refining Processes** Petroleum Properties, Coking, Fluid catalytic cracking, Hydrotreatment, hydrocracking, Reforming, natural gas processing	6	0
4	**Soaps and Detergents** Classification of oils, fat splitting, rancidity, saponification value, iodine number, acid value, Soap and Synthetic Detergent, preparation of soap and detergent, different types of soap and their composition, surfactants (LAS, ABS, LABS), detergent binders and builders.	8	0
5	**Pulp and paper** Cellulose derivatives: Pulp, paper and boards, Types of raw material for pulping, Various pulping methods, Recovery of chemicals from black liquor, Manufacture of paper, Quality improvement of paper.	8	0
6	**Manufacturing of Petrochemicals** Manufacturing process of methanol, Acetic acid, Vinyl Acetate, Poly Vinyl Acetate, Manufacturing process of styrene, Polystyrene, Styrene butadiene rubber	8	0
7	**Introduction to Polymers** Classification of polymer, molecular weight, mechanical properties, thermal properties, monomer	4	0
8	**Manufacturing of Commercial Polymer** Low density polyethylene, High density polyethylene, Polyvinylchloride, Polyethylene terephthalate.	8	0
	Total	56	0

15. Suggested Books:

Sl. No.		**Year of Publication / Reprint**
1	Chemical Process Technology by J Moulijn, M Makkee and A Diepen	2001
2	Dryden's outlines of chemical technology for the 21st century by M Gopala Rao, Marsal Sitting	2003
3	Introduction to Polymer Sciences and Chemistry: A Problem Solving Approach by Manas Chanda	2013
4	Chemical process Industries by Shreve, Brink and Austin	1984
5	Riegel's Handbook of Industrial Chemistry edited by James A. Kent	2003

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COURSE DETAILS FOR VARIOUS ACADEMIC PROGRAMME

Name of the Programme: ITEP-Chemistry

Core course for Chemistry Major students.

Name of the School: Basic Sciences

1.	**Course Title:**	Organometallic and Bioinorganic Chemistry
2.	**Subject Code:**	CY3L301
3.	**L: T: P:**	4-0-0
4.	**Credit:**	4
5.	**Semester No:**	V
6.	**Core/Elective/Breadth:**	Core
7.	**Contact Hours:**	56
8.	**Theory:**	Yes
9.	**(Autumn/ Spring):**	Autumn
10.	**Level:**	B.Sc.-B.Ed.
11.	**Pre- requisite:**	None
12.	**Lab:**	None

13. **Objective of Course:**

This course aims to provide students with a comprehensive understanding of fundamental organometallic chemistry and its applications. The study of bioinorganic chemistry give a comprehensive understanding of the pivotal role of metal ions in biological systems by studying different bioinorganic systems and models. Inorganic materials will also be covered to equip students with a practical understanding of the diverse applications of inorganic materials, catalysts, pigments, corrosion protection agents, and mineral fertilizers in various industries and sectors. Environmental chemistry will be covered to develop an understanding of the key principles governing the behaviour of contaminants in the environment, and to explore the environmental issues related to atmospheric composition, climate change, biogeochemical cycles, pollution, and effective control measures.

14. Lecture -wise Break up

Sl. No.	Course Contents	Contact Hours/ No. of Lectures	No. of Tutorial / Practical
1	**Organometallic chemistry** Historic overview organometallics, Electron counting rules for stability and reactivity, metal-metal bond(s). Ligand	22 Lectures	0

	classifications: σ, π-donor and π-acceptor, metal carbonyls, synergic effect of CO. Metal-R bonded compounds. Metallocenes. Fluxional properties organometallic compounds. Oxidative addition, reductive elimination, insertion reactions. Metal carbenes –Fischer and Schrock, carbynes. Catalysis: hydrogenation, hydroformylation, Carbonylation, cross-coupling reactions, Wacker process, olefin methathesis, TON, TOF.		
2	**Bioinorganic chemistry** Metal ions (trace and ultra-trace) in biological systems, metallobiomolecules, metal ion in bio-coordination chemistry, dioxygen chemistry; myoglobin, hemoglobin, hemocyanin and hemerythrin. Bimetallic compounds with diiron sites: MMO, RNR. Metalloenzymes: Carbonic anhydrase, carboxypeptidase and vitamin B_{12}, small molecule models for metallo-biosites. Metal ion - sulfide proteins: Rubredoxin, ferredoxin and nitrogenases. Metalloporphyrins in respiration and photosynthesis: Cytochromes and electron transfer reactions.	16 Lectures	0
3	**Molecules and materials in applications** Inorganic solid materials and catalysts: alumina, silicates, Clays, mica, zeolites. Inorganic pigments: TiO_2, lithopone, ZnS, ZnO, Fe_2O_3. Corrosion protection pigments. Mineral fertilizers: nitrogen fertilizers, ammonium nitrate, urea, phosphorous-containing fertilizers.	8 Lectures	0
4	**Environmental chemistry** Atmospheric composition and principles of contaminant behavior. Greenhouse effect, acid rain and ozone layer depletion. Carbon Cycle, Nitrogen Cycle, Sulphur Cycle. Organic pollutants. Photochemical smog. Indoor air pollution. Air pollution control techniques. Ground and sub-surface water contamination. Soil Pollution. Solid waste management.	10 Lectures	0
	Total	56 Lectures	0

15. Suggested Books:

Sl. No.		Year of Publication / Reprint
1	The Organometallic Chemistry of the Transition Metals, by R.H. Crabtree	2014
2	Basic Organometallic Chemistry: Concepts, Syntheses and Applications of Transition Metals B.D. Gupta and Anil. J. Elias	2013
3	Chemistry of Environment by Bailey, Clark, Ferris, Krause, and Strong	2002
4	Principles & Applications of Organo-transition Metal Chemistry, by J.P. Collman, L.S. Hegedus, J.R. Norton, R.G. Finke	1987
5	Bioinorganic Chemistry by Lippard, and Bartini	1994

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COURSE DETAILS FOR VARIOUS ACADEMIC PROGRAMME

Name of the Programme: ITEP-Chemistry

Core course for Chemistry Major students.

Name of the School: Basic Sciences

1.	**Course Title:**	QUANTUM CHEMISTRY AND MOLECULAR SPECTROSCOPY
2.	**Subject Code:**	CY3L302
3.	**L: T: P:**	4-0-0
4.	**Credit:**	4
5.	**Semester No:**	V
6.	**Core/Elective/Breadth:**	Core
7.	**Contact Hours:**	56
8.	**Theory:**	Yes
9.	**(Autumn/ Spring):**	Autumn
10.	**Level:**	B.Sc.-B.Ed.
11.	**Pre- requisite:**	Nil
12.	**Lab:**	No

13. Objective of Course:

This course will provide a depth knowledge, and a quantum mechanical approach about the subject of physical chemistry/molecular spectroscopy.

14. Lecture -wise Break up

Sl. No.	Course Contents	Contact Hours/ No. of Lectures	No. of Tutorial / Practical
1	**Introduction to Quantum Chemistry:** a. Beginning of Quantum Mechanics: Wave-particle duality, light as particles: photoelectric and compton effects; electrons as waves and the de Broglie hypothesis; Uncertainty relations. b. Wave function: Schrodinger time-independent equation; nature of the equation, acceptability conditions imposed on the wave functions and probability interpretations of wave function.	30	

	c. Concept of Operators: Elementary concepts of operators, eigenfunctions and eigenvalues; Linear operators; Commutation of operators, commutator and uncertainty relation; Expectation value; Hermitian operator; Postulates of Quantum Mechanics. d. Particle in a box: Setting up of Schrodinger equation for one-dimensional box and its solution; Comparison with free particle eigenfunctions and eigenvalues. Properties of particle in a box wave functions (normalisation, orthogonality, probability distribution); Expectation values of x, x^2 , p_x and $p_x{}^2$ and their significance in relation to the uncertainty principle; Extension of the problem to two and three dimensions and the concept of degenerate energy levels. e. Angular momentum: Commutation rules, quantization of square of total angular momentum and z-component; Rigid rotator model of rotation of diatomic molecule; Schrödinger equation, transformation to spherical polar coordinates; Separation of variables. f. Qualitative treatment of hydrogen atom and hydrogen-like ions: Setting up of Schrödinger equation in spherical polar coordinates, radial part, quantization of energy (only final energy expression); Average and most probable distances of electron from nucleus; Setting up of Schrödinger equation for many-electron atoms (He, Li). g. LCAO and HF-SCF: Covalent bonding, valence bond and molecular orbital approaches, LCAO-MO treatment of $H_2{}^+$; Bonding and antibonding orbitals; Qualitative extension to H_2; Comparison of LCAO-MO and VB treatments of H_2 and their limitations; Hartree-Fock method development, SCF and configuration interaction (only basics).		
2	**Molecular Spectroscopy:** a. Concepts of Spectroscopy, wavelength and frequency, Unit of energy, Light-matter interaction (Quantum mechanical approach), Various types of spectroscopy b. Electronic spectroscopy: Born-Oppenheimer approximation, Electronic transitions and Selection rules, Potential energy curves (diatomic molecules), Frank Condon principle and vibrational structure of electronic spectra; Bond dissociation and principle of determination of dissociation energy (ground state); Decay of excited states by radiative and non-radiative paths; Pre-dissociation; Fluorescence and phosphorescence, Jablonski diagram, Absorption spectroscopy and Lambert Beer's law, Absorption coefficients, singlet and triplet states, fluorescence and phosphorescence spectroscopy, Fluorescence quantum yield, Calculation of electronic transitions of polyenes using free electron model. c. Vibrational spectroscopy: Classical equation of vibration, Simple harmonic oscillator and vibrational transition, Anharmonic oscillator and Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies, Dipole moment and IR active molecules. d. Rotation spectroscopy: Principle for diatomic rigid rotor, Moment of inertia and reduced mass, Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution, Microwave active molecules. e. Vibration-rotation spectroscopy: Diatomic vibrating rotator, P, Q, R branches.	26	

	f. Raman spectroscopy: Principle, Stokes and anti-Stokes lines; Polarizability and Raman active molecules, Rule of mutual exclusion. g. Nuclear Magnetic Resonance (NMR) spectroscopy: Principles, Larmor precession, chemical shift and low resolution spectra. h. Electron Spin Resonance (ESR) spectroscopy: Principles, ESR of simple radicals.		
	Total	56	

15. Suggested Books:

Sl. No.		**Year of Publication / Reprint**
1	Levine I. N. and Hall P. Quantum Chemistry, Prentice-Hall	
2	Schatz G. C. and Ratner M. A. Quantum Mechanics in Chemistry, Dover	
3	Macquarie, D. A. Quantum Chemistry, University Science Books	
4	Chandra, A. K. Introductory Quantum Chemistry, Tata McGraw-Hill Education	
5	Pauling L. and Wilson (Jr) E. B. Introduction to Quantum Mechanics with Applications to Chemistry, Dover	
6	C. B. Banwell, “Fundamentals of Molecular Spectroscopy”, Tata McGrawHill	
7	H. E. White, “Introduction to Atomic Spectra”, Tata McGrawHill	
8	G. M. Barrow, “Molecular Spectroscopy”, Tata McGrawHill	
9	H. Herzberg, “Spectra of Diatomic Molecules”, Springer	
10	J. D. Graybeal, “Molecular Spectroscopy”, Tata McGrawHill	

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COURSE DETAILS FOR VARIOUS ACADEMIC PROGRAMME

Name of the Programme: ITEP-Chemistry

Core course for Chemistry Major students.

Name of the School: Basic Sciences

1.	**Course Title:**	Organic Chemistry Lab-II
2.	**Subject Code:**	CY3P301
3.	**L: T: P:**	0-0-3
4.	**Credit:**	2
5.	**Semester No:**	V
6.	**Core/Elective/Breadth:**	Core
7.	**Contact Hours:**	42
8.	**Theory:**	None
9.	**(Autumn/ Spring):**	Autumn
10.	**Level:**	B.Sc.-B.Ed.
11.	**Pre- requisite:**	None
12.	**Lab:**	Yes

13. Objective of Course:

The objective of this course is to familiarize students about basic organic synthesis and product analysis.

14. Lecture -wise Break up

Sl. No.	Course Contents	Contact Hours/ No. of Lectures	No. of Tutorial / Practical
1	**Separation of leaf pigments from spinach leaves by TLC**	3	1
2	**Separation of organic compounds by column chromatography**	3	1
3	**Ester hydrolysis and purification of acid**	3	1
4	**Synthesis of Nylon 6.6**	3	1

5	**Bromo derivatization and melting point analysis**	3	1
6	**Benzil-benzilic acid rearrangement**	3	1
7	**Synthesis of aspirin from salicylic acid**	3	1
8	**Analysis by NMR Spectroscopy**	3	1
9	**Analysis by Fluorescence Spectroscopy**	3	1
10	**Pericyclic reaction**	3	1
11	**Reduction reaction using hydride reagents**	3	1
12	**Nitration of aromatic compounds**	3	1
	Mid semester and End Semester Examination	6	
	Total	42	12 nos.

15. Suggested Books:

Sl. No.		**Year of Publication / Reprint**
1	A text book of Practical Organic Chemistry by A. I. Vogel	1989
2	Experimental Organic Chemistry (Vol.I and II) – Singh, Gupta and Bajpai	1981
3	Handbook of Organic Analysis, Qualitative and Quantitative by M. T. Clarke	1975

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COURSE DETAILS FOR VARIOUS ACADEMIC PROGRAMME

Name of the Programme: ITEP-Chemistry

Core course for Chemistry Major students.

Name of the School: Basic Sciences

1.	**Course Title:**	Inorganic Chemistry Lab-II
2.	**Subject Code:**	CY3P302
3.	**L: T: P:**	0-0-3
4.	**Credit:**	2
5.	**Semester No:**	V
6.	**Core/Elective/Breadth:**	Core
7.	**Contact Hours:**	42
8.	**Theory:**	No
9.	**(Autumn/ Spring):**	Autumn
10.	**Level:**	B.Sc.-B.Ed.
11.	**Pre- requisite:**	None
12.	**Lab:**	Yes

13. Objective of Course:

This course will enhance practical laboratory skills and understanding of analytical and synthetic techniques, including gravimetric analysis, iodimetry, permanganometry, and complex compound synthesis. Additionally, to gain insight into environmental chemistry through the determination of chemical oxygen demand (COD) and biological oxygen demand (BOD). These skills are directly applicable in various scientific and industrial contexts, fostering proficiency in experimental inorganic chemistry.

14. Lecture -wise Break up

Sl. No.	Course Contents	Contact Hours/ No. of Lectures	No. of Tutorial / Practical
1	Estimation of nickel (II) using dimethylglyoxime (DMG). (Gravimetric analysis)	3	1
2	Estimation of Cu (II) and $K_2Cr_2O_7$ using sodium thiosulphate solution (Iodimetrically).	3	1
3	To separate a mixture of Ni^{2+} & Fe^{3+} by complexing with DMG, extracting the Ni^{2+} DMG complex in chloroform and determine its concentration	3	1

4	Preparation of tris(ethylenediamine)nickel(II) chloride.	3	1
5	Preparation of potassiumbis(oxalato)cuprate(II) dehydrate.	3	1
6	Preparation of tetraamminecarbonatocobalt(III) nitrate.	3	1
7	Preparation of potassium tris(oxalato)chromate(III) trihydrate.	3	1
8	Preparation of aluminium potassium sulphate $KAl(SO_4)_2.12H_2O$ (Potash alum) or Chrome alum.	3	1
9	Preparation of Manganese(III)phosphate, $MnPO_4.H_2O$	3	1
10	Preparation of $Mn(acac)_3$ and determination of its λ max colorimetrically.	3	1
11	Determination of biological oxygen demand (BOD).	3	1
12	Determination of chemical oxygen demand (COD).	3	1
	Mid semester and end semester examination	6	0
	Total	42	12

15. Suggested Books:

Sl. No.		**Year of Publication / Reprint**
1	Vogel's Qualitative Inorganic Analysis	2012
2	Vogel's Textbook of Quantitative Chemical Analysis	2009

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COURSE DETAILS FOR VARIOUS ACADEMIC PROGRAMME

Name of the Programme: ITEP-Chemistry

Core course for Chemistry Major students.

Name of the School: Basic Sciences

1.	**Course Title:**	Medicinal Chemistry
2.	**Subject Code:**	CY3L303
3.	**L: T: P:**	4-0-0
4.	**Credit:**	4
5.	**Semester No:**	VI
6.	**Core/Elective/Breadth:**	Core
7.	**Contact Hours:**	56
8.	**Theory:**	Yes
9.	**(Autumn/ Spring):**	Spring
10.	**Level:**	B.Sc.-B.Ed.
11.	**Pre- requisite:**	Organic Spectroscopy
12.	**Lab:**	None

13. Objective of Course:

The objective of this course is to familiarize students about the basics of drug design, their mode of actions and classifications.

14. Lecture -wise Break up

Sl. No.	Course Contents	Contact Hours/ No. of Lectures	No. of Tutorial / Practical
1	**Introduction to Medicinal Chemistry** History and development of medicinal chemistry, physicochemical properties in relation to biological action: ionization, solubility, partition coefficient, hydrogen bonding, protein binding, chelation, bioisosterism, optical and geometrical isomerism, drug metabolism and concepts of prodrugs.	10	0
2	**Principles of Drug Design**	8	0

	Traditional analogue and mechanism based approaches, steric and electronic effects, lipophilicity effects.		
3	**Chirality and drug action** Realization that stereoselectivity is a pre-requisite for evolution, role of chirality in selective and specific therapeutic agents, case studies, enantioselectivity in drug absorption, metabolism, distribution and elimination	8	0
4	**Amino acids, peptide, nucleotides and related drugs** Thyroid and Anti thyroid drugs, Insulin and oral hypoglycaemic agents, synthesis, mode of action and structure activity relationship	10	0
5	**Synthesis and activity of selected drugs** Synthetic procedures of selected drugs, mode of action, uses, structure activity relationship including physicochemical properties, paracetamol, ibuprofen, aspirin, penicillin, ficlofenac, thalidomide, cetirizine and others	20	0
	Total	56	0

15. Suggested Books:

Sl. No.		Year of Publication / Reprint
1	An Introduction to Medicinal Chemistry by Graham L. Patrick	2013
2	Medicinal Chemistry by P Yogeeswari, D. Sriram,	2009
3	Medicinal Chemistry by Ashutosh Kar	2005
4	Textbook of Medicinal Chemistry Vol I and II by V. Alagarsamy	2013

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COURSE DETAILS FOR VARIOUS ACADEMIC PROGRAMME

Name of the Programme: ITEP-Chemistry

Core course for Chemistry Major students.

Name of the School: Basic Sciences

1.	**Course Title:**	COMPUTATIONAL CHEMISTRY
2.	**Subject Code:**	CY3L304
3.	**L: T: P:**	3-0-2
4.	**Credit:**	4
5.	**Semester No:**	VI
6.	**Core/Elective/Breadth:**	Core
7.	**Contact Hours:**	56
8.	**Theory:**	Yes
9.	**(Autumn/ Spring):**	Spring
10.	**Level:**	B.Sc.-B.Ed.
11.	**Pre- requisite:**	Nil
12.	**Lab:**	Yes

13. **Objective of Course:**

This course will provide a depth knowledge, and a hand-on experience on the calculation of quantum mechanical/statistical approach about the subject of physical chemistry.

14. Lecture -wise Break up

Sl. No.	Course Contents	Contact Hours/ No. of Lectures	No. of Tutorial / Practical
1	**Introduction and Numerical Methods (Lecture 7)** 1. Introduction 2. Basic Programming Techniques 3. Interpolation and Curve Fitting 4. Roots of Equations 5.	7	2

	Matrix Methods 6. Differential Equations 7. Numerical Integration 8. Integral Transforms.		
2	**Quantum mechanical calculations** 9. Ab initio methods –I (Hartree Fock) 10. Ab initio methods - II (Post Hartree Fock) 11. Density functional methods 12. Softwares for quantum mechanical calculations 13. Different forms of inputs for Ab initio calculations, 14. Computation of single point energies 15. Geometry optimization 16. Electron densities and electrostatic potentials 17. Analysis of output for Gausian programmes – I 18. Analysis of output for Gausian programmes - II 19. Molecular frequencies 20. Modeling in solutions - I 21. Modeling in solutions - II 22. Thermodynamic functions 23. NMR frequencies 24. QSAR 25. Transition states.	15	6
3	**Concepts of statistical mechanics and Classical Simulations (Lecture 9)** 26. Potential Models 27. Concept of Periodic Boundary Conditions (PBC) 28. Generalized coordinates 29. Solution of equations of motions using Finite Difference Methods 30. Basics of Statistical Mechanics - concept of ensemble; time average vs. ensemble average properties 31. Concept of Temperature in simulations 32. Development of a molecular dynamics (MD) code for Lennard-Jones fluids 33. Monte Carlo (MC) method 34. Development of a MC code 35. Analysis of simulated data	15	4
4	**Biomolecular simulations** 36. Polypeptide conformations (Aqueous and non aqueous media) – I 37. Polypeptide conformations – II 38. Polypeptide conformations – III 39. Structure of DNA and RNA-I 40. Structure of DNA and RNA-II	5	2
5	**Computational Chemistry Practical**		

	Total	42	14

22. Suggested Books:

Sl. No.		Year of Publication / Reprint
1	Levine I. N. and Hall P. *Quantum Chemistry*, Prentice-Hall.	
2	Allen M. P. and Tildesley D. J. *Computer Simulation of Liquids*, Clarendon Press, Oxford.	
3	Wong S. S. M. *Computational Methods in Physics*, World Scientific.	
4	Leach A. R, *Molecular Modelling*: Principles and applications, Prentice-Hall.	