CURRICULUM FOR INTEGRATED TEACHER EDUCATION PROGRAMME LEADING TO B. Sc. B.Ed. DEGREE

Name of Degree	Name of Specialization	Total Intake (Full-time)	Year of Starting	Duration	Eligibility for Admission
B.Sc. B.Ed. (Secondary)	Science and Education	50	2023	4 years (8 semesters)	The ITEP shall be of four academic years, comprising eight semesters, including an internship (field-based experiences and practice teaching). Candidates with a minimum fifty percent marks in Senior Secondary or plus two examination or its equivalent (under 5+3+3+4 pattern) from a recognized board are eligible for admission through the National Common Entrance Test (NCET), conducted by the National Testing Agency (NTA)

COURSE CATEGORIES AND CREDIT REQUIREMENTS:

The structure of B.Sc.B.Ed. Programmes shall have the following Course Categories:

Sl. No	Course Category	No. of Courses	No. of credits
1.	Foundations of Education (FE)	10	30
2.	Disciplinary Major and Minor (MM)	16	80
3.	Stage Specific Content cum Pedagogy (CP)	4	16
4.	Ability Enhancement and Value added Courses (AE)	12	28
5.	School Experience (SE)	6	20
6.	Community Engagement and Service (CE)	1	2

Total Credits required: 176

PROGRAMME STRUCTURE

Major Disciplinary Subject: CHEMISTRY

Minor: One discipline to be chosen from amongst Mathematics, Physics, Botany, Zoology and Economics.

The effort to be put in by the student is indicated in the tables below as follows:

L: Lecture (One unit is of 50-minute duration)
T: Tutorial (One unit is of 50-minute duration)
P: Practical (One unit is of one-hour duration)
O: Outside the class effort / self-study (One unit is of one-hour duration)

Semester 1

Sl. No	Course Code	Title	L	T	P	O	C	Category
1	ED1001E	Evolution of Indian Education	4	0	0	8	4	FE
2	ED1002E	Language I – English	4	0	0	8	4	AE
3	ED1003E	Art Education-Collage Making	1	0	2	3	2	AE
4	ED1004E	Understanding India -I	2	0	0	4	2	AE
5	ED1101E	Structure, Bonding and Fundamentals of Spectroscopy	3	1	0	8	4	MM
6	ED1202E	Mathematics Minor-I Mathematics- I Calculus	3	1	0	8	4	MM
	ED1303E	Physics Minor-I Mechanics, Waves and Oscillations	3	1	0	8	4	MM
	ED1401E	Botany Minor-I Cell Biology and Biochemistry	3	1	0	8	4	MM
	ED1501E	Zoology Minor-I Cell Biology	3	1	0	8	4	MM
	ED1601E	Economics Minor-I Basic Economics	3	1	0	8	4	MM
7	ED1102E	Inorganic Chemistry Laboratory	0	0	2	1	1	MM
		Total					21	

Semester 2

Sl. No	Course Code	Title	L	T	P	O	C	Category
1	ED1011E	Language II- Malayalam	4	0	0	8	4	AE
	ED1014E	Language II- Hindi	4	0	0	8	4	AE
2	ED1012E	Understanding India – II	2	0	0	4	2	AE
3	ED1013E	Teacher and Society	2	0	0	4	2	AE
4	ED1111E	Basic Concepts in Organic Chemistry and Stereochemistry	3	1	0	8	4	MM
5	ED1112E	States of Matter and Chemical Thermodynamics	3	1	0	8	4	MM
6	ED1213E	Mathematics Minor-II Mathematics- II- Algebra & Differential Equations	3	1	0	8	4	MM
	ED1314E	Physics Minor-II Thermal Physics	3	1	0	8	4	MM
	ED1411E	Botany Minor-II Biotechnology, Molecular Biology and Bioinformatics	3	1	0	8	4	MM
	ED1511E	Zoology Minor-II Animal Biotechnology	3	1	0	8	4	MM
	ED1611E	Economics Minor-II Microeconomics	3	1	0	8	4	MM
7	ED1113E	Physical Chemistry Laboratory	0	0	2	1	1	MM
		Total					21	

Semester 3

Sl. No	Course Code	Title	L	T	P	O	C	Category
1	ED2001E	Child Development and Educational Psychology	4	0	0	8	4	FE
2	ED2002E	General Pedagogy	3	1	0	8	4	CP
3	ED2101E	Coordination Chemistry and its Applications	3	1	0	8	4	MM
4	ED2102E	Thermodynamics, Kinetics and Equilibria	3	1	0	8	4	MM
5	ED2203E	Mathematics Minor-III Mathematics- III-Probability and Statistics	3	1	0	8	4	MM
	ED2304E	Physics Minor-III, Electromagnetism and Relativity	3	1	0	8	4	MM
	ED2401E	Botany Minor-III Ecology and Environmental Science	3	1	0	8	4	MM
	ED2501E	Zoology Minor-III Environmental Conservation and Sustainable Development	3	1	0	8	4	MM
	ED2601E	Economics Minor III Indian Economy: Trends and Policies	3	1	0	8	4	MM
6	ED2103E	Organic Chemistry Laboratory	0	0	2	1	1	MM
		Total					21	

Semester 4

Sl. No	Course Code	Title	L	T	P	O	C	Category
1	ED2011E	Philosophical and Sociological Perspectives of Education-I	4	0	0	8	4	FE
2	ED2012E	Minor Pedagogy (Physical Science)	3	1	0	8	4	CP
	ED2013E	Minor Pedagogy (Mathematics)						
	ED2014E	Minor Pedagogy (Biological Science)	3	1	0	8	4	CP
	ED2015E	Minor Pedagogy (Social Science)	3	1	0	8	4	CP
3	ED2111E	Basic analytical chemistry and Introductory Electrochemistry	3	1	0	8	4	MM
4	ED2112E	Synthetic Methodologies in Organic Chemistry	3	1	0	8	4	MM
5	ED2213E	Mathematics Minor-IV Mathematics-IV-Mathematical Analysis	3	1	0	8	4	MM
	ED2314E	Physics Minor-IV Basic Electronics	3	1	0	8	4	MM
	ED2411E	Botany Minor-IV Structural Biology	3	1	0	8	4	MM
	ED2511E	Zoology Minor-IV Bioinformatics	3	1	0	8	4	MM
	ED2611E	Economics Minor IV- Money and Personal Finance	3	1	0	8	4	MM
6	ED2113E	Instrumental methods in Chemical analysis	0	0	2	1	1	MM
		Total					21	

Semester 5

Sl. No	Course Code	Title	L	T	P	O	C	Categor y
1	ED3001E	ICT in Education	1	0	2	3	2	AE
2	ED3002E	Major Pedagogy-I (Physical Sciences)	3	1	0	8	4	CP
3	ED3003E	Pre-internship Practice	0	0	3	3	2	SE
4	ED3101E	Chemistry of Main Group Elements and Organometallic Chemistry	3	1	0	8	4	MM
5	ED3102E	Natural Products, Heterocycles and Spectroscopic Methods of Characterization	3	1	0	8	4	MM
6	ED3103E	Major Project	0	0	0	12	4	MM
		Total					20	

Semester 6

Sl. No	Course Code	Title	L	T	P	O	C	Category
1	ED3011E	Assessment and Evaluation	2	0	0	4	2	FE
2	ED3012E	Major Pedagogy-II (Physical Sciences)	3	1	0	8	4	CP
3	ED3013E	Inclusive Education	2	0	0	4	2	FE
4	ED3014E	Mathematical and Quantitative Reasoning	1	1	0	4	2	AE
5	ED3015E	School Observation	0	0	0	6	2	SE
6	ED3111E	Solid State Chemistry	3	1	0	8	4	MM
	ED3112E	Fundamentals of Biochemistry	3	1	0	8	4	MM
	ED3113E	Surface Chemistry	3	1	0	8	4	MM
	ED3114E	Basic Analytical Chemistry and Instrumental methods	3	1	0	8	4	MM
	ED3115E	Chemistry of Multiple Bonds	3	1	0	8	4	MM
	ED3116E	Nuclear Chemistry	3	1	0	8	4	MM
	ED3117E	Physical Methods in Inorganic Chemistry	3	1	0	8	4	MM
	ED3118E	Bioinorganic Chemistry	3	1	0	8	4	MM
		Total					16	

Semester 7

Sl. No	Course Code	Title	L	T	P	O	C	Category
1	ED4001E	Perspectives on School Leadership and Management	2	0	0	4	2	FE
2	ED4002E	Curriculum Planning and Development	2	0	0	4	2	FE
3	ED4003E	Art Education- Performing and Visual	1	0	2	3	2	AE
4	ED4004E	Sports, Nutrition and Fitness	1	0	2	3	2	AE
5	ED4005E	School-based Research Project	0	0	0	6	2	SE
6	ED4006E	Internship in Teaching	0	0	0	30	10	SE
7	ED4101E	Advanced Inorganic Chemistry	3	1	0	8	4	MM
8	ED4102E	Quantum Chemistry	3	1	0	8	4	MM
		Total					28	

Semester 8

Sl. No	Course Code	Title	L	T	P	O	C	Category
1	ED4011E	Philosophical and Sociological Perspectives of Education-II	4	0	0	8	4	FE
2	ED4012E	Education Policy Analysis	2	0	0	4	2	FE
3	ED4019E	Emerging Technologies in Education	4	0	0	8	4	FE
	ED4020E	Guidance and counselling	4	0	0	8	4	FE
4	ED4014E	Yoga and Understanding Self	2	0	0	4	2	AE
5	ED4015E	Citizenship Education, Sustainability and Environment Education	2	0	0	4	2	AE
6	ED4016E	Post-Internship (Review and Analysis)	0	0	3	3	2	SE
7	ED4017E	Teaching Learning Material/Work Experience	0	0	3	3	2	SE
8	ED4018E	Community Engagement and Service	0	0	3	3	2	CE
9	ED4103E	Advanced Organic Chemistry	3	1	0	8	4	MM
10	ED4104E	Chemical Kinetics and Surface Chemistry	3	1	0	8	4	MM
		Total					28	

Semester-wise distribution of credits:

Semester	1	2	3	4	5	6	7	8
Credit	21	21	21	21	20	16	28	28

Detailed Syllabus of newly added courses

ED4101E Advanced Inorganic Chemistry

Pre-requisites: NIL

L	T	P	O	C
3	1	0	8	4

Total Lecture Sessions: 52

Course Outcomes:

CO1: Learn about the basic concepts and principles of inorganic chemistry and be able to think innovatively
CO2: Study various properties of main group elements and their related compounds to enable the synthesis of new inorganic compounds.
CO3: Know about the importance of nuclear chemistry, its related reactions and their applications.

Chemical bonding-Valence bond theory, hybridization, VSEPR theory, molecular orbital theory, applications of MOs for homo and heteronuclear diatomic molecules, and symmetry of molecular orbitals.

Introduction to acid-base concepts-Bronsted-Lowry definition, Lux-Flood definition, Lewis definition, Hard and Soft Acids and Bases concept (HSAB).

Main Group Chemistry-General discussion on the properties of main group elements, boron cage compounds, structure and bonding in polyhedral boranes, carboranes and metalloboranes, STYX notation, Wade's rule, synthesis of polyhedral boranes and carboranes, silicones, silicates, boron nitride, borazines and phosphazenes, oxides and oxoacids of nitrogens (N, P), chalcogens (S, Se & Te) and halogens pseudo-halogens and interhalogen compounds, xenon compounds, and allotropes of carbon and silicon. Reduction potentials-Latimer and Frost diagrams.

Inner Transition Metals: Introduction to lanthanides and actinides, position of lanthanides/actinides, physical properties including electronic structure and oxidation states, lanthanide and actinide contractions, optical spectra and magnetic properties of lanthanides, applications of lanthanide complexes, and transactinide elements.
Nuclear Chemistry-Introduction, radioactivity and measurement, radioactive series, half-life, nuclear decay, Bethe's notation of nuclear process, types of nuclear reactions, and nuclear fission.

References:

1. J. E. Huheey, E. A. Keiter, R.L. Keiter, and O. K. Medhi, *Inorganic Chemistry, Principles of Structure and Reactivity*, Pearson India Ltd., 2009.
2. F. A. Cotton, G. Wilkinson, C. A. Murillo and M. Bochmann, *Advanced Inorganic Chemistry*, John Wiley & Sons, Inc., New York, 2009.
3. J. D. Lee, *Concise Inorganic Chemistry,* Blackwell Science, Oxford, 2008.
4. P. Atkins, T. Overton, J. Rourke, M. Weller and F. Armstrong, *Shriver & Atkins: Inorganic Chemistry*, 5th edition, Oxford University Press, Oxford, 2010.
5. C. E. Housecroft and A. G. Sharpe, *Inorganic Chemistry*, Pearson, 2012.
6. G. Choppin, J. Rydberg and J. O. Liljenzin, *Radiochemistry and Nuclear Chemistry*, Butterworth-Heinemann, 3rd Edition, 2002.
7. W. D. Loveland, D. Morrissey and G. T. Seaborg, *Modern Nuclear Chemistry*, John Wiley & Sons, 2006.

ED4102E QUANTUM CHEMISTRY

Pre-requisites: NIL

L	T	P	O	C
3	1	0	8	4

Total Lecture Sessions: 52

Course Outcomes:
CO1: Apply the concepts of quantum mechanics to simple chemical systems.
CO2: Demonstrate the application of fundamental laws to solve chemical problems.
CO3: Apply suitable approximation to solve the Schrödinger equation for simple systems.

Wave-particle duality - postulates - operators, linear and Hermitian operators, commutation relations, eigenvalue problem - Heisenberg and Schrödinger representations of quantum mechanics - solution for Schrödinger equation - particle in 1D, 2D, 3D boxes and their applications - degeneracy - particle in a box of finite barrier and quantum mechanical tunneling.

Simple harmonic oscillator - Solution by the method of power series, Hermite equation, Hermite polynomials, recursion relation, wave functions and energies - Particle in a sphere and hydrogen atom -Wave equation in spherical polar coordinates, separation of center of mass motion from relative motion, separation of variables, Legendre and associated Legendre polynomials, spherical harmonics, polar diagrams, wave functions and energies of hydrogen-like atoms, Laguerre and associated Laguerre polynomials, radial functions, radial distribution functions, angular functions and their plots - Postulate of spin, discovery of spin, spin orbitals.

Angular momentum, quantum mechanical operators, commutation relations, eigenfunctions, Ladder operator method for angular momentum, space quantization.

Many electron atoms (He), approximation methods: independent particle method, perturbation method (treatment of the ground state of He atom), variation method (treatment of the ground state of He atom), self-consistent field approximation, Slater type orbitals, symmetric and antisymmetric wave functions, Pauli's exclusion principle, vector model of atom; spin-orbit coupling, spectroscopic term symbols for atoms, Russel-Saunder's terms and coupling schemes, introduction to SCF methods, Slater determinants, Hartree and Hartree-Fock's SCF.

References:

1. P. W. Atkins, *Molecular Quantum Mechanics*, Oxford University Press, New York, 2005.
2. D. A. McQuarrie, *Quantum Chemistry*, University Science Books, Mill Valley CA.,1983.
3. M. W. Hanna, *Quantum Mechanics in Chemistry*, Benjamin/Cummings, Melano Park, CA, 1981.
4. R. K. Prasad, *Quantum Chemistry*, Oscar Publications, New Delhi, 2000.
5. I. N. Levine, *Quantum Chemistry*, 5th Edition, Pearson Educ., Inc., New Delhi, 2000.
6. S. N. Datta, *Lectures on Chemical bonding and quantum chemistry*, Prism Books, Bangalore, 1997.
7. J. P. Lowe, *Quantum Chemistry*, 2nd Edition, Academic Press Inc., 1993.
8. A. K. Chandra, *Introduction to Quantum Chemistry*, 4th Edition, Tata McGraw-Hill, 1994.

ED4103E ADVANCED ORGANIC CHEMISTRY

Pre-requisites: NIL

L	T	P	O	C
3	1	0	8	4

Total Lecture Sessions: 52

Course Outcomes:

CO1: Deliver methods for the synthesis of compounds containing C=C/C=X bonds and their reactions.
CO2: Deliver the principles and application of pericyclic reactions.
CO3: Predict the outcome of the reactions based on the various rearrangement reactions.

Formation and selected reactions of C-C double bond: β-Elimination reactions, stereoselective and regioselective eliminations, β-eliminations *via* cyclic transition states: sulfoxides, selenoxides, *N*-oxides, acetates and xanthates eliminations; Wittig, Horner Wadsworth Emmons, Peterson, Bamford, Stevens, Shapiro, Corey-Winter reactions, Julia olefination, McMurry coupling - Selected reactions of alkenes: hydration of alkenes, hydroboration reactions, halolactonization.

Chemistry of carbonyl group: nucleophilic addition to the carbonyl group, the addition of nitrogen, oxygen and sulphur nucleophiles: imine, enamine, hemiacetal, acetal and thioacetals; C-C bond formation via enolates and enamines, methods of formation, kinetic/thermodynamic control and regio- and stereoselectivity in enolate formation; reactions of enolates, acetoacetic and malonic ester synthesis, condensation with carbonyl compounds, Aldol and Michael reactions, reactions of enamines, enamines in Aldol and Michael reactions; Claisen, Dieckmann, Knoevenagel, Stobbe, Perkin and Darzen condensations.

Pericyclic reactions: classification, Woodward Hoffmann rules, FMO analysis, orbital symmetry correlations and transition state aromaticity methods for electrocyclic, cycloaddition and sigmatropic reactions; pericyclic reaction in organic synthesis – Diels-Alder reactions, 1,3-dipolar additions, Cope, Claisen and Ireland-Claisen rearrangements; chelotropic, group transfer and ene reactions.

Types of rearrangements, rearrangement involving carbocations: Wagner Meerwein rearrangement, Pinacol and semipinacol rearrangement, Demjanov rearrangement, benzylic acid rearrangement; rearrangement to electron-deficient oxygen: Baeyer Villiger oxidation, hydroperoxide rearrangement, Dakin reaction; rearrangement to electron-rich carbon: Steven's rearrangement, Sommelet-Hauser rearrangement, Wittig rearrangement, Favorskii rearrangement; rearrangement to electron-deficient nitrogen: Wolf, Hofmann, Curtius, Schmidt, Lossen and Beckmann rearrangements.

References:

1. R. Bruckner, *Advanced Organic Chemistry, Reaction Mechanisms*, 1st Edition, Academic Press, California, USA, 2002.
2. F. A. Carey and R. J. Sundberg, *Advanced Organic Chemistry, Part A: Structure and Mechanisms*, 5th Edition, Springer, Boston, USA, 2007.
3. J. J. Li, *Name Reactions: A Collection of Detailed Mechanism and Synthetic Applications*, 4th Edition, Springer, New York, 2009.
4. I. Fleming, *Pericyclic Reactions,* 2nd edition, Oxford University Press, UK, 2015.
5. S. Sankararaman, *Pericyclic reactions – A Textbook*: *Reactions, Applications and Theory,* Wiley-VCH, Weinheim, Germany, 2005.
6. M. B. Smith, March's, *Advanced Organic Chemistry*: *Reactions, Mechanisms and Structure*, 7th Edition, John-Wiley & Sons, Inc., New Jersey, 2013.
7. W. Carruthers and I. Coldham, *Modern Methods of Organic Synthesis,* 4th Edition, Cambridge University Press, UK, 2004.
8. R. O. C. Norman, J. M. Coxon, *Principles of Organic Synthesis*, 3rd edition, CRC Press, UK, 1993.

ED4104E CHEMICAL KINETICS AND SURFACE CHEMISTRY

Pre-requisites: NIL

L	T	P	O	C
3	1	0	8	4

Total Lecture Sessions: 52

Course Outcomes:

CO1: Calculate the rate of reaction and kinetic triplet for chemical reactions.
CO2: Elucidate the reaction mechanisms using established reaction rate theories.
CO3: Postulate surface reactions in catalyzed chemical reactions.
CO4: Correlate the theory, predictions and mechanisms for industrially relevant chemical reactions.

Empirical Rate Laws - Complex Reactions, Parallel, Opposing and Consecutive Reactions - Collision and Transition State Theories of Rate Constants, Thermodynamic Formulation of Transition State Theory, Linear and Non-linear Arrhenius equations, Arrhenius Parameters; Activation Energy, Statistical Distribution of Molecular Energies - Steady State Approximation - Unbranched and Branched Chain Reaction - Determination of Reaction Mechanisms, Theories of Unimolecular Reactions - Radical and Ionic Polymerization Reactions - Photochemical Reactions - Potential Energy Surfaces ($D + H_2 \rightarrow DH + H$, $D_2 + H_2 \rightarrow 2DH$) – Kinetics of Fast Reactions and Relaxation Kinetics.

Kinetics of Reactions in Solution - Comparison Between Gas Phase and Solution Phase Reactions, Cage Effect, Factors Determining the Reaction Rates in Solution, Reactions Between Ions, Ion Dipole and Dipole-Dipole Reactions - Structure, Pressure Effect, Primary and Secondary Salt Effects - Homogeneous Catalysis, General Catalytic Mechanisms, Acid-Base Catalysis, Catalysis by Enzymes, Inhibition, Transient, Phase Kinetics, Sigmoid Kinetics.

Processes at Solid Surfaces, Thermodynamics and Kinetics of Adsorption, Adsorption Isotherms, Adsorption Entropies, BET equation and its Applications, Adsorption on Porous Solids, Hysteresis - Langmuir Blodgett Films - Heterogenous Catalysis, Adsorption and Catalysis, Unimolecular Surface Reactions, Bimolecular Surface Reaction, Langmuir-Hinshelwood Mechanism.

Micelles, Emulsions, and Foams, Critical Micelle Concentration (CMC) - Temperature Dependence, Influence of Chain Length and Salt Concentration, Surfactant Parameter, Thermodynamics of Micellization, Aging and Stabilization of Emulsions, Micelles and Microemulsion as Templates for Synthesis of Nanostructures.

References:

1. P. Atkins, J. de Paula, *Physical chemistry*, 10th Edition, Oxford university press, Oxford, 2014.
2. J. I Steinfeld, J.S. Francisco and W. L. Hase, *Chemical Kinetics and Dynamics*, 2nd Edition, Prentice Hall, 1998.
3. K. J. Laidler, *Chemical Kinetics*, 3rd Edition, 1997, Benjamin-Cummings, Indian reprint - Pearson, 2009.
4. A. W. Adamson and A. P. Gast, *Physical Chemistry of Surfaces*, Wiley, 1997.
5. H. -J. Butt, K. Graf and M. Kappl, *Physics and Chemistry of Interfaces*, Wiley-VCH, 2006.
6. H. Kuhn, H. -D. Forsterling and D.H. Waldeck, *Principles of Physical Chemistry*, Wiley, 2009.
7. G. A. Somorjai and Y. Li, *Introduction to Surface Chemistry and Catalysis,*2nd Edition, 2010.
8. R. J. Silbey, R. A. Alberty and M. G. Bawendi, *Physical Chemistry*, 4th Edition, 2014.
9. B. R. Puri, L. R. Sharma, M. S. Pathania, *Principles of Physical Chemistry*, 48th Edition, Vishal Publishing Co, Jalandhar, 2021