Centurion University of Technology & Management
School of Applied Sciences

B. Sc. (Chemistry Hons.)
CBCS syllabus

(Three Years Programme)

2018

Semester Wise Course Structure

CHOICE BASED CREDIT SYSTEM IN B.Sc.(Honours)

Semester	Basket-1	Basket-2	Basket-3+4		Basket-5		
Sl. No.	CORE COURSE (14) Total 84 Credits	Ability Enhancement Compulsory Course (AECC) (2) Total 4 Credits	Domain** From Same/Related Discipline Minimum 26 Credits	Non-Domain [Skill Enhancement Course (SEC)-(2) Minimum 4 Credits + Discipline Specific Elective(DSE)- (4)] Minimum 24 credits	Non-Domain Generic Elective(GE) (4)	Domain** from Other Discipline Minimum 26 Credits	Semester wise Cumulative Credits
I	C 1 C2	(English / MIL Communication)/ Environmental Science	Domain Course of minimum 26 credits upto a maximum of 36 credits		GE – 1	Domain Course of minimum 26 credits upto a maximum of 36 credits	Minimum 20 Credits
II	C 3 C 4	Environmental Science/(English/ MIL Communication)			GE – 2		Minimum 20 Credits
III	C 5 C 6 C 7			SEC – 1	GE – 3		Minimum 26 Credits
IV	C 8 C 9 C 10			SEC – 2	GE - 4		Minimum 26 Credits
V	C 11 C 12			DSE – 1 DSE – 2			Minimum 24 Credits
VI	C 13 C 14			DSE – 3 DSE (Project)– 4			Minimum 24 Credits
Total Credits							Minimum 140
* A student can opt more number of **Domain /GE courses** up to a maximum of 20 credits over the period of six semesters.							Maximum 160
**Each Domain must contain a Skill Component							

Basket-1

Core Courses (CC)

Sl. No.	Code	Subject Name	Type of course	T-P-Pr (Credit)	Credits
1	BSCH1101	Inorganic chemistry-I	Theory + Practice	4-2-0	6
2	BSCH1102	Physical Chemistry-I	Theory + Practice	4-2-0	6
3	BSCH1201	Organic Chemistry-I	Theory + Practice	4-2-0	6
4	BSCH1202	Physical Chemistry-II	Theory + Practice	4-2-0	6
5	BSCH2301	Inorganic chemistry-II	Theory + Practice	4-2-0	6
6	BSCH2302	Organic Chemistry-II	Theory + Practice	4-2-0	6
7	BSCH2303	Physical Chemistry-III	Theory + Practice	4-2-0	6
8	BSCH2401	Inorganic Chemistry-III	Theory + Practice	4-2-0	6
9	BSCH2402	Organic Chemistry-III	Theory + Practice	4-2-0	6
10	BSCH2403	Physical Chemistry-IV	Theory + Practice	4-2-0	6
11	BSCH3501	Organic Chemsitry-IV	Theory + Practice	4-2-0	6
12	BSCH3502	Physical Chemsitry-V	Theory + Practice	4-2-0	6

13	BSCH3601	Inorganic Chemistry-IV	Theory + Practice	4-2-0	6
14	BSCH3602	Organic Chemistry-V	Theory + Practice	4-2-0	6

Basket-2

Ability Enhancement Compulsory Course (AECC)

Sl. No.	Code	Subject Name	Type of course	T-P-Pr (Credit)	Credits
1	BSFL1101 OR FCBS0101	English OR Environmental Science	Theory	2-0-0	2

Basket-3+4

Domain / Non Domain Courses

DOMAIN – PHARMACEUTICAL CHEMISTRY

Sl. No	Code	Subject Name	Type of Courses	T-P-Pr(Credit)	Credits
1	DEPC0101	Basic Herbal Technology	Theory	2-0-0	2
2	DEPC0201	Extraction and Isolation of Drugs	Practice	0-2-0	2
3	DEPC0202	Chemical Identification of Drugs	Practice	0-2-0	2
4	DEPC0401	Chemistry of Biomolecules	Theory + Practice	2-2-0	4
5	DEPC0402	Physical Chemistry of Pharmaceuticals	Theory + Practice	2-2-0	4
6	DEPC0403	Essentials of Pharmaceutical Chemistry	Theory + Practice	2-2-0	4
7	DEPC0404	Analytical Techniques for Pharmaceutical Drugs	Theory + Practice	2-2-0	4
8	DEET0300	Project	Project	0-0-6	6

Non Domain Courses (DSE Courses)

Sl. No.	Code	Subject Name	Type of course	T-P-Pr (Credit)	Credits
1	BSCH3503	Industrial Chemicals and Environment	Theory+ Practice	4-2-0	6
2	BSCH3504	Inorganic Materials of Industrial Importance	Theory+ Practice	4-2-0	6
3	BSCH3603	Research Methodology for Chemistry	Theory+ Practice	4-2-0	6
4	BSCH3604	Instrumental Methods of Chemical Analysis	Theory+ Practice	4-2-0	6

Skill Enhancement Courses

Sl. No.	Code	Subject Name	Type of course	T-P-Pr (Credit)	Credits
1	BSCH2001	Basic Pharmaceutical Chemistry	Practice	0-0-2	2
2	BSCH2002	Analytical Clinical Biochemistry	Practice	0-0-2	2
3	BSCH2003	Green Methods in Chemistry	Practice	0-0-2	2
4	BSCH2004	Basic Analytical Chemistry	Practice	0-0-2	2

Note: Any two (for Non-Domain)/any-one or as deemed fit (for Domain) Skill Enhancement Courses to be chosen from the above list.

Basket-5

Generic Elective (GE)

(Subjects from other Disciplines)

Basket-1

Core Courses (CC)

BSCH1101 Inorganic Chemistry-I

Subject Name	Code	Type of course	T-P-P	Prerequisite
Inorganic Chemistry-I	**BSCH1101**	• Theory & Lab	4-2-0	Fundamentals of Chemistry

Objective

- To study and compare between the various theories of atomic structure.
- To know the most common structures and hybridization observed for different compounds.
- To use periodic trends to understand the chemistry of the alkali metals, alkaline earth metals, halogens, transition as well as inner transition elements.

Learning outcome

- The student will acquire knowledge in the structure, bonding, hybridization of different compounds, their periodic properties and the quantum mechanical aspect.

- Understand and employ selected techniques for the calculating atomic number, atomic mass, quantum number, bond order, bond length using a variety of methods.
- Plan and carry out laboratory experiments, including data analysis and conclusions.
- Describe simple approaches for troubleshooting.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test	*20*	Written examination
	Assignment	*15*	Report and Presentation
	Experiments	*15*	Lab work, report
	Project	*Nil*	Report and presentation
	Quiz	*Nil*	Surprise/preannounced ones
External Examination		*50*	Written examination
Total		*100*	

Course Outline

Module-I (6 Hrs.)
Atomic Structure-1:
Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrodinger's wave equation, significance of Ψ and Ψ^2.

Module-II (8 Hrs.)
Atomic Structure-2:
Quantum numbers and their significance. Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of s, p, d and *f* orbital's. Contour boundary and probability diagrams. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number.

Module-III (8 Hrs.)
Periodicity of Elements-1:
s, p, d, f block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to s and p-block.
Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table. Atomic radii (van der Waals), Ionic and crystal radii, Covalent radii (octahedral and tetrahedral)

Module-IV (8 Hrs.)
Periodicity of Elements-2:
Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy. Electron gain enthalpy, trends of electron gain enthalpy. Electronegativity, Pauling's/ Mulliken's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity.

Module-V(10 Hrs.)
Chemical Bonding-1:
Ionic bond: General characteristics, types of ions, size effects, radius ratio rule and its limitations. Packing of ions in crystals. Born-Lande equation Madelung constant, Born-Haber cycle and its application, solvation energy.

Module-VI (16 Hrs.)
Chemical Bonding-2:
Covalent bond: Lewis structure, Valence Bond theory (Heitler-London approach). Energetic of hybridization, equivalent and non-equivalent hybrid orbitals, Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules Formal charge, Valence shell electron pair repulsion theory (VSEPR), Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization. Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electronegativity difference.

Module-VII (4 Hrs.)
Oxidation-Reduction:
Redox equations, Standard Electrode Potential and its application to inorganic reactions. Principles involved in volumetric analysis to be carried out in class.

Recommended Books:

- Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
- Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry, Oxford, 1970.
- Atkins, P.W. & Paula, J. Physical Chemistry, 10th Ed., Oxford University Press, 2014.
- Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications, 1962.
- Rodger, G.E. Inorganic and Solid State Chemistry, Cengage Learning India Edition, 2002.

Inorganic Chemistry Practice

Inorganic Chemistry-I Lab:

A. Titrimetric Analysis
B. Calibration and use of apparatus.

- Preparation of solutions of different Molarity/Normality of titrants

B. Acid-Base Titrations

- Estimation of carbonate and hydroxide present together in mixture.
- Estimation of carbonate and bicarbonate present together in a mixture.
- Estimation of free alkali present in different soaps/detergents

C. Oxidation-Reduction Titrimetry

- Estimation of Fe(II) and oxalic acid using standardized $KMnO_4$ solution.
- Estimation of oxalic acid and sodium oxalate in a given mixture.
- Estimation of Fe(II) with $K_2Cr_2O_7$.

Recommended Books:

- Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009
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BSCH 1102 Physical Chemistry-I

Subject Name	Code	Type of course	T-P-P	Prerequisite
Physical Chemistry I	BSCH1102	• Theory+lab	4-2-0	State of matter learning in intermediate classes

Objective

- The Course structure gives the idea about the use of four physical properties pressure, volume, number of particles and temperature. Their detailed studies ultimately led to a mathematical relationship among these.
- The Course structure gives the idea about the liquid are the only **state** with a definite volume but no fixed shape. A **liquid** is made up of tiny vibrating particles of **matter**, such as atoms, held together by intermolecular bonds
- The equilibrium established between the unionized molecules and the ions in the solution of weak electrolytes is called ionic equilibrium

Learning outcome

- After complication of the course student will be able to understand and able to know how the gaseous state of molecule properties can explain by different gases laws and also explain the nature of existence of gas molecule in the different parameter.
- After completion of the course, students will able to understand The liquid state of matter is an intermediate phase between solid and gas.
- After completion of the course, students will able to understand this lesson talks about ionic equilibrium and solubility product of sparingly soluble salts. It also shows how to calculate pH of a solution and solubility product/solubility of sparingly soluble salts

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test	nil	Written examination
	Assignment	30	Report and Presentation
	Experiments	20	nil
	Project	nil	nil
	Quiz	nil	nil
External Examination		50(20+30)	Written examination
Total		100	

Course outline

Module-I (6 Hrs.)

Gaseous state:-1
Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, calculation of o from n; variation of viscosity with temperature and pressure.

Module-II (8 Hrs.)

Gaseous state-2

Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities. Behaviour of real gases: Deviations from ideal gas behaviour, compressibility factor, Z, and its variation with pressure for different gases.

Module-III (4 Hrs.)

Gaseous state-3
Causes of deviation from ideal behaviour. Van der Waals equation of state, its derivation and application in explaining real gas behaviour, Isotherms of real gases and their comparison with van der Waals isotherms, continuity of states, critical state, relation between critical constants and van der Waals constants, law of corresponding states.

Module-IV (6 Hrs.)

Liquid state:
Qualitative treatment of the structure of the liquid state; Radial distribution function; physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity. Explanation of cleansing action of detergents. Temperature variation of viscosity of liquids and comparison with that of gases. Qualitative discussion of structure of water.
Solid state:
Module-V (6 Hrs.)

Solid state:
Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, CsCl and KCl. Defects in crystals. Glasses and liquid crystals.

Module-VI (10 Hrs.)

Ionic Equilibria-1: Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono-, di-, and triprotic acids (exact treatment). Salt hydrolysis: Calculation of hydrolysis constant, degree of hydrolysis and pH for different salts.

Module-VII (10 Hrs.)

Ionic Equilibria-2:
Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer range, buffer action and applications of buffers in analytical chemistry and biochemical processes in the human body. Solubility and solubility product of sparingly soluble salts - applications of solubility product principle. Qualitative treatment of acid - base titration curves (calculation of pH at various stages). Theory of acid-base indicators; selection of indicators and their limitations. Multistage equilibria in polyelectrolyte systems; hydrolysis and hydrolysis constants.

Recommended Books:

- Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry 10th Ed., Oxford University 12 Press (2014).
- Ball, D. W. Physical Chemistry Thomson Press, India (2007).
- Castellan, G. W. Physical Chemistry 4^{th} Ed. Narosa (2004).

- Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP (2009).
- Engel, T. & Reid, P. Physical Chemistry 3rd Ed. Pearson (2013).

Physical Chemistry Practice

pH-metry

- Study the effect on pH of addition of HCl/NaOH to solutions of acetic acid, sodium acetate and their mixtures.
- Preparation of buffer solutions of different pH
- Sodium acetate-acetic acid
- Ammonium chloride-ammonium hydroxide
- pH metric titration of
- strong acid vs. strong base
- weak acid vs. strong base.
- Determination of dissociation constant of a weak acid.

Recommended Books:

- Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
- Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003).
- Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York (2003).

BSCH1201 Organic Chemistry-I

Subject Name	Code	Type of course	T-P-P	Prerequisite
Organic Chemistry-I	BSCH1201	•Theory & Lab	4-2-0	NIL

Objective

- The general concept of this course is to train students the fundamental laboratory skills like extraction, purification and separation techniques with some simple organic preparations.
- This helps students to gain experience to predict the functional group transformations, simple reaction mechanisms, and the synthesis of organic molecules by multi-step synthesis strategies

Learning outcome

- Students will have a firm foundation in the fundamentals and application of current chemical and scientific theories including those in Analytical, Inorganic, Organic and Physical Chemistries.
- They will be able to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments.
- Students will be able to explore new areas of research in both chemistry and allied fields of science and technology.

Evaluation Systems

Internal Examination	Component	% of Marks	Method of Assessment
	Midterm Test		Written examination
	Assignment	30	Report and Presentation

	Experiments	20	Lab work, report
	Project	nil	Report and presentation
	Quiz	nil	Surprise/preannounced ones
External Examination		50(20+30)	Written examination
Total		100	

Course outline

Module-I (6 Hrs.)
Basics of Organic Chemistry:
Organic Compounds: Classification, and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties. Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength.

Module-II (6 Hrs.)

Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophlicity and basicity; Types, shape and their relative stability of Carbocations, Carbanions, Free radicals and Carbenes. Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

Module-III (8 Hrs.)

Stereochemistry:
Fischer Projection, Newmann and Sawhorse Projection formulae and their interconversions; Geometrical isomerism: cis-trans and, syn-anti isomerism E/Z notations with C.I.P rules. Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral-centres, Distereoisomers, meso structures, racemic mixture and resolution. Relative and absolute configuration: D/L and R/S designations.

Module-IV (8 Hrs.)
Chemistry of Aliphatic Hydrocarbons: Carbon-Carbon sigma bonds:Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation -relative reactivity and selectivity.

Module-V (12 Hrs.)
Carbon-Carbon pi bonds:
Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations.Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration-demercuration, hydroborationoxidation,ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1,2-and 1,4-addition reactions in conjugated dienes and, Diels-Alder reaction;Allylic and benzylic bromination and mechanism, e.g. propene, 1- butene, toluene, ethyl benzene. Reactions of alkynes: Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes.

Module-VI (8 Hrs.)
Cycloalkanes and Conformational Analysis:
Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformation analysis of alkanes: Relative stability: Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms; Relative stability with energy diagrams.

Module-VII (8 Hrs.)
Aromatic Hydrocarbons:
Aromaticity: Huckel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directing effects of the groups.

Recommended Books:

- Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London, 1994.
- Kalsi, P. S. Stereochemistry Conformation and Mechanism, New Age International, 2005.
- McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.

Organic Chemistry Practice

Checking the calibration of the thermometer

- Purification of organic compounds by crystallization method.
- Determination of the melting points of above compounds and unknown organic compounds (Kjeldahl method and electrically heated melting point apparatus)
- Effect of impurities on the melting point - mixed melting point of two unknown organic compounds
- Determination of boiling point of liquid compounds. (boiling point lower than and more than 100 °C by distillation and capillary method)
- Chromatography separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer Chromatography (TLC)

Recommended Books:

- Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
- Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012).

BSCH1202 Physical Chemistry-II

Subject Name	Code	Type of course	T-P-P	Prerequisite
Physical Chemistry-II	BSCH1202	• Theory & Lab	4-2-0	Intermediate in Science

Objective

- The Course covers all the aspects of Thermodynamics, it's different laws and Phenomena

- Different laws of thermodynamics and limitations as well as their correlations and applications to day to day life.
- Various thermo dynamical Practices
- Pre requirement: Intermediate in Science

Learning outcome

- After completion of the course student should able to understand different thermodynamic activities happening in everyday life in nature.
- They should know different chemical equilibriums and relationship between them.
- They should have a general idea about elevation in boiling point and depression in freezing point, their conditions of occurrence and effects.
- They should able to know why there is lowering in vapour pressure , Rault's law , Henry's law and their applications
- They should have practical experiences on how to calculate heat capacity of calorimeter from known enthalpy of solution or enthalpy of neutralization.
- They will know how to determination of basicity/proticity of a polyprotic acid by the thermochemical method

Evaluation Systems

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Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test		Written examination
	Assignment	*30*	Report and Presentation
	Experiments	*20*	Lab work, report
	Project		Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		*30+20=50*	Written examination
Total		*100*	

Module-I **Course Outline** **(20 Hrs.)**

Chemical Thermodynamics:

Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics, First law: statement of first law, relation between heat capacities, Thermochemistry: Heats of reactions: standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, effect of temperature (Kirchhoff s equations) and pressure on enthalpy of reactions, adiabatic flame temperature.

Module-II **(9 Hrs.)**

Second Law of Thermodynamics:

Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics; molecular and statistical interpretation of entropy, Calculation of entropy change for reversible and irreversible processes.

Module-III **(9 Hrs.)**

Third Law: Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules. Free Energy Functions: Gibbs and Helmholtz energy; Relation between Joule-Thomson coefficient and other thermodynamic parameters; inversion temperature; Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state.

Module-IV **(5Hrs)**

Systems of Variable Composition:
Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs-Duhem equation, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases.

Module-V **(7 Hrs)**

Chemical Equilibrium:
Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases, concept of fugacity. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient, Equilibrium constants and their quantitative dependence on temperature, pressure and concentration. Free energy of mixing and spontaneity.

Module-VI **(6Hrs)**

Thermochemistry: Thermodynamic derivation of relations between the various equilibrium constants Kp, Kc and Kx. Le Chatelier principle (quantitative treatment); equilibrium between ideal gases and a pure condensed phase Solutions and Colligative Properties:

Module-VII **(7Hrs)**

Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications. Excess thermodynamic functions, Thermodynamic derivation using chemical potential to derive relations between the four colligative properties and amount of solute. Applications in calculating molar masses of normal, dissociated and associated solutes in solution.

Recommended Books:

- Peter, A. & Paula, J. de. Physical Chemistry 10th Ed., Oxford University Press (2014).
- Castellan, G. W. Physical Chemistry 4th Ed., Narosa (2004).
- Engel, T. & Reid, P. Physical Chemistry 3rd Ed., Prentice-Hall (2012).
- McQuarrie, D. A. & Simon, J. D. Molecular Thermodynamics Viva Books Pvt. Ltd.New Delhi (2004).
- Assael, M. J.; Goodwin, A. R. H.; Stamatoudis, M.; Wakeham, W. A. & Will, S. Commonly Asked Questions in Thermodynamics. CRC Press: NY (2011).
- Levine, I .N. Physical Chemistry 6th Ed., Tata Mc Graw Hill (2010).
- Metz, C.R. 2000 solved problems in chemistry, Schaum Series (2006).

Physical Chemistry-II Practice

Thermochemistry

- Determination of heat capacity of a calorimeter for different volumes using change of enthalpy data of a known system (method of back calculation of heat capacity of calorimeter from known enthalpy of solution or enthalpy of neutralization).
- Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
- Calculation of the enthalpy of ionization of ethanoic acid.
- Determination of heat capacity of the calorimeter and integral enthalpy (endothermic and exothermic) solution of salts.
- Determination of basicity/proticity of a polyprotic acid by the thermochemical method in terms of the changes of temperatures observed in the graph of temperature versus time for different additions of a base. Also calculate the enthalpy of neutralization of the first step.
- Determination of enthalpy of hydration of copper sulphate.

- Study of the solubility of benzoic acid in water and determination of AH.
- Any other experiment carried out in the class.

Recommended Books:

- Khosla, B. D.; Garg, V. C. & Gulati, A., Senior Practical Physical Chemistry, R.Chand & Co.: New Delhi (2011).
- Athawale, V. D. & Mathur, P. Experimental Physical Chemistry New Age International: New Delhi (2001).

BSCH2301 Inorganic Chemistry-II

Subject Name	Code	Type of course	T-P-P	Prerequisite
Inorganic Chemistry-II	**BSCH2301**	Theory & Lab	4-2-0	Fundamentals of Chemistry

Objective

- To identify the common physical properties of metals and non- metals and explain how their uses relate to these properties.
- To explore in depth specialized areas of chemistry of materials, including ores, metals, acids and bases and to understand how metals are extracted from their ores.
- To understand the trends in properties and reactivity of the s, p-block elements and noble gases.
- To become familiar with some of the roles of inorganic polymer and its applications in day to day life.

Learning outcome

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- Discuss fundamental aspects of main group chemistry, including trends in oxidation states, periodic properties and complex formation tendency.
- The resulting knowledge primarily serves the success of students pursuing research in the field of chemical metallurgy.
- To familiar with a variety of different methods for synthesizing inorganic materials and principles of inorganic polymer synthesis.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test	*20*	Written examination
	Assignment	*15*	Report and Presentation
	Experiments	*15*	Lab work, report
	Project	*Nil*	Report and presentation
	Quiz	*Nil*	Surprise/preannounced ones
External Examination		*50*	Written examination
Total		*100*	

Course outline

Module-I(4Hrs.)

General Principles of Metallurgy-1:
Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agent. Electrolytic Reduction, Hydrometallurgy. Methods of purification of metals: Electrolytic Kroll process, Parting process, Mond's process, Zone refining.

Module-II (3Hrs.)
Acids and Bases:
Bronsted-Lowry concept of acid-base reactions, solvated proton, relative strength of acids, types of acid-base reactions, levelling solvents, Lewis acid-base concept, Classification of Lewis acids, Hard and Soft Acids and Bases (HSAB) Application of HSAB principle.

Module-III(5Hrs.)

Chemistry of *s* and *p* Block Elements-1:
Inert pair effect, Relative stability of different oxidation states, diagonal relationship and anomalous behaviour of first member of each group. Allotropy and catenation. Complex formation tendency of *s* and *p* block elements.

Module-IV(10Hrs.)
Chemistry of *s* and *p* Block Elements-2:
Hydrides and their classification ionic, covalent and interstitial. Basic beryllium acetate and nitrate. Study of the following compounds with emphasis on structure, bonding, preparation, properties and uses. Boric acid and borates, boron nitrides, borohydrides (diborane) carboranes and graphitic compounds, silanes.

Module-V (8Hrs.)
Chemistry of *s* and *p* Block Elements-3:
Oxides and oxoacids of nitrogen, Phosphorus and chlorine. Peroxo acids of sulphur, interhalogen compounds, polyhalide ions, pseudohalogens and basic properties of halogens

Module-VI (7Hrs.)
Noble Gases:
Occurrence and uses, rationalization of inertness of noble gases, Clathrates; preparation and properties of XeF_2, XeF_4 and XeF_6; Nature of bonding in noble gas compounds (Valence bond treatment and MO treatment for XeF2). Molecular shapes of noble gas compounds (VSEPR theory).

Module-VII (5Hrs.)

Inorganic Polymers:
Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones and siloxanes. Borazines, silicates and phosphazenes, and polysulphates.

Recommended Books:
1. *Lee, J.D. Concise Inorganic Chemistry, ELBS, 1991.*
2. Douglas, B.E; Mc Daniel, D.H. & Alexander, J.J. *Concepts & Models of Inorganic Chemistry 3rd*

Ed., John Wiley Sons, N.Y. 1994.

Reference

3. Greenwood, N.N. & Earnshaw. *Chemistry of the Elements*, Butterworth-Heinemann. 1997.
4. Cotton, F.A. & Wilkinson, G. *Advanced Inorganic Chemistry*, Wiley, VCH, 1999.
5. Rodger, G.E. *Inorganic and Solid State Chemistry*, Cengage Learning India Edition, 2002.
6. Miessler, G. L. & Donald, A. Tarr. *Inorganic Chemistry* 4th Ed., Pearson, 2010.
7. Atkin, P. *Shriver & Atkins' Inorganic Chemistry* 5th Ed. Oxford University Press (2010).

Inorganic Chemistry Practice

A. Iodo / Iodimetric titration

1. Estimation of Cu(II) and K2Cr2O7 using sodium thiosulphate solution iodometrically.
2. Estimation of available chlorine in bleaching powder.

B. Inorganic preparation

1. Cuprous chloride, Cu_2Cl_2.
2. Preparation of potash alum, K_2SO_4 $Al_2(SO_4)_3.24H_2O$.
3. Preparation of Manganese (III) phosphate, $MnPO_4.H_2O$.

Recommended Books:

Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.

BSCH2302 Organic Chemistry-II

Subject Name	Code	Type of course	T-P-P	Prerequisite
Organic Chemistry-II	BSCH2302	•Theory & Lab	4-2-0	

Objective

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- The aim of this course to introduce basic practical skills including safe working practices (risk, hazard and control measures
- In addition of that, the course will also help students to understand the reaction mechanism subjects in later stages of their study.

Learning outcome

- Students will appreciate the central role of chemistry in our society and use this as a basis for ethical behavior in issues facing chemists including an understanding of safe handling of chemicals, environmental issues and key issues facing our society in energy, health and medicine.
- Students will be able to clearly communicate the results of scientific work in oral, written and electronic formats to both scientists and the public at large.

Evaluation Systems

Internal Examination	Component	% of Marks	Method of Assessment
	Midterm Test		Written examination
	Assignment	30	Report and Presentation
	Experiments	20	Lab work, report
	Project	nil	Report and presentation
	Quiz	nil	Surprise/preannounced ones
External Examination		50(30+20)	Written examination
Total		100	

Course outline

Module-I (7 Hrs.)

Chemistry of Halogenated Hydrocarbons-1:
Alkyl halides: Methods of preparation, nucleophilic substitution reactions - SN1, SN2 and SNi mechanisms with stereochemical aspects and effect of solvent etc.

Module-II (8 Hrs.)

Chemistry of Halogenated Hydrocarbons-2: Nucleophilic substitution vs. elimination.Aryl halides: Preparation, including preparation from diazonium salts. nucleophilic aromatic substitution; SNAr, Benzyne mechanism.
Relative reactivity of alkyl, allyl /benzyl, vinyl and aryl halides towards nucleophilic substitution reactions. Organometallic compounds of Mg and Li - Use in synthesis of organic compounds.

Module-III (7 Hrs.)

Alcohols, Phenols, Ethers and Epoxides:
Alcohols: preparation, properties and relative reactivity of 1°, 2°, 3° alcohols, Bouvaelt-Blanc Reduction; Preparation and properties of glycols: Oxidation by periodic acid and lead tetraacetate, Pinacol-Pinacolone rearrangement;

Module-IV (8 Hrs.)

Phenols: Preparation and properties; Acidity and factors effecting it, Ring substitution reactions, Reimer- Tiemann and Kolbe's-Schmidt Reactions, Fries and Claisen rearrangements with mechanism;
Ethers and Epoxides: Preparation and reactions with acids. Reactions of epoxides with alcohols, ammonia derivatives and LiAlH.

Module-V (6 Hrs.)

Carbonyl Compounds-1:
Structure, reactivity and preparation; Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism; Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Claisen-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckmann and Benzil-Benzilic acid rearrangements,

Module-VI (6 Hrs.)

Carbonyl Compounds-2:
Haloform reaction and Baeyer Villiger oxidation, a- substitution reactions, oxidations and reductions (Clemmensen, Wolff-Kishner, LiAlH NaBH MPV, PDC and PGC); Addition reactions of unsaturated carbonyl compounds: Michael addition.Active methylene compounds: Keto-enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate.

Module-VII (8 Hrs.)

Carboxylic Acids and their Derivatives:
Preparation, physical properties and reactions of monocarboxylic acids: Typical reactions of dicarboxylic acids, hydroxy acids and unsaturated acids: succinic/phthalic, lactic, malic, tartaric, citric, maleic and fumaric acids;Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparativestudy of nucleophilic sustitution at acyl group -Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Dieckmann and Reformatsky reactions, Hofmannbromamide degradation and Curtius rearrangement. Sulphur containing compounds:Preparation and reactions of thiols, thioethers and sulphonic acids.

Recommended Books:
1. Morrison, R. T. & Boyd, R. N. *Organic Chemistry,* Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. *Organic Chemistry (Volume* 1), Dorling Kindersley (India) Pvt. Ltd.
(Pearson Education).
3. Graham Solomons, T.W. *Organic Chemistry,* John Wiley & Sons, Inc.
4. McMurry, J.E. *Fundamentals of Organic Chemistry,* 7th Ed. Cengage Learning India Edition, 2013.

Organic Chemistry Practice

1. Functional group test for alcohol, Phenols, Carbonyl and Carboxylic acid group.
2. Organic preparation
   a) Acetylation of Acetanilide/Aspirin.
   b) Oxidation of p-nitro benzoicacid.
   c) Bromination of Acetanilide.
   d) Nitration of nitro benzene/p-nitro acetanilide.
   e) Reduction of meta dinitro benzene to meta nitro aniline.
   f) Hydrolysis of ester.
   g) Benzlic acid rearrangement

Recommended Books:
1. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry,* Pearson Education (2009)
2. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. & Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.* Pearson (2012)
3. *Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry:Preparation and Quantitative Analysis, University Press (2000).22*
4. *Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry:*
Qualitative Analysis, University Press (2000)

BSCH 2303 Physical Chemistry-III

Subject Name	Code	Type of course	T-P-P	Prerequisite
Physical Chemistry III	BSCH2303	•Theory & Lab	4-2-0	

Objective

- The course gives idea about the different phases of matter and their equilibria from which the stability and sustainability can be easily predicted
- Deals with kinetics study of different processes and surface phenomenon like adsorption, chemisorptions etc.

Learning outcome

- After completion of the syllabus the students will be able to understand different phases of matter and work with phase diagrams while dealing with different phases in advanced research and industrial applications
- They shall also know the kinetics of chemical reaction and tune the processes as per the requirements
- Also they will have sound knowledge regarding different surface phenomenon.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test	*20*	Written examination
	Assignment	*10*	Report and Presentation
	Experiments	*20*	Lab work, report
	Project	-	Report and presentation
	Quiz	-	Surprise/preannounced ones
External Examination		*50*	Written examination
Total		*100*	

Course outline

Module-I (4 Hrs.)

Phase Equilibria-1:

Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule for Non-reactive and reactive systems; Clausius-Clapeyron equation and its applications to solid-liquid, liquid-vapour and solid- vapour equilibria

Module-II (6 Hrs.)

Phase Equilibria-2:

Phase diagram for one component systems, with applications. Phase diagrams for systems of solid-liquid equilibria involving eutectic, congruent and incongruent melting points, solid solutions. Three component systems, water-chloroform-acetic acid system, triangular plots.

Module-III (5 Hrs.)

Phase Equilibria-3:
Binary solutions: Gibbs- Duhem-Margules equation, its derivation and applications to fractional distillation of binary miscible liquids (ideal and nonideal), azeotropes, lever rule, partial miscibility of liquids, CST, miscible pairs, steam distillation. Nernst distribution law: its derivation and applications.

Module-IV (10 Hrs.)

Chemical Kinetics-1:
Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated form of rate expressions up to second order reactions, experimental methods of the determination of rate laws, kinetics of complex reactions (integrated rate Expressions up to first order only): (i) Opposing reactions (ii) parallel reactions and (iii) Consecutive reactions and their differential rate equations (steady-state approximation in reaction mechanisms) (iv) chain reactions.

Module-V (5 Hrs.)

Chemical Kinetics-2:
Temperature dependence of reaction rates; Arrhenius equation; activation energy. Collision theory of reaction rates, Lindemann mechanism, qualitative treatment of the theory of absolute reaction rates.

Module-VI (10 Hrs.)

Catalysis:
Types of catalyst, specificity and selectivity, mechanisms of catalyzed reactions at solid surfaces; effect of particle size and efficiency of nanoparticles as catalysts. Enzyme catalysis, Michaelis-Menten mechanism, acid-base catalysis.

Module-VII (5 Hrs.)
Surface chemistry:
Physical adsorption, chemisorption, adsorption isotherms, nature of adsorbed state.

Recommended Books:

1. Peter Atkins & Julio De Paula, *Physical Chemistry* 10th Ed., Oxford University Press (2014).
2. Castellan, G. W. *Physical Chemistry,* 4th Ed., Narosa (2004).
3. McQuarrie, D. A. & Simon, J. D.,*Molecular Thermodynamics*, Viva Books Pvt. Ltd.: New Delhi (2004).
4. Engel, T. & Reid, P. *Physical Chemistry 3rd Ed.,* Prentice-Hall (2012).
5. Assael, M. J.; Goodwin, A. R. H.; Stamatoudis, M.; Wakeham, W. A. & Will, S.

Commonly Asked Questions in Thermodynamics. CRC Press: NY (2011).
6. Zumdhal, S.S. *Chemistry concepts and applications* Cengage India (2011).
7. Ball, D. W. *Physical Chemistry* Cengage India (2012).
8. Mortimer, R. G. *Physical Chemistry 3rd Ed.,* Elsevier: NOIDA, UP (2009).
9. Levine, I. N. *Physical Chemistry 6th Ed.,* Tata McGraw-Hill (2011).
10. Metz, C. R *Physical Chemistry 2nd Ed.,* Tata McGraw-Hill (2009).

Physical Chemistry Practice

1. Study the distribution law of Acetic acid and benzoic acid by water and carbon tetra chloride.
2. Effect of ionic strength on rate of persulphate iodide reaction
3. Integrated rate method

a) Acid hydrolysis of methyl acetate with hydrochloric acid

b) Saponification value of ethyl acetate

4. Verify the Freundlich and Langmuir isotherm for adsorption of acetic acid on activated charcoal.

Recommended Books

1. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed.;* McGraw-Hill: New York (2003).
3. *Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H.* Freeman & Co.: New York (2003).

BSCH2401 Inorganic Chemistry-III

Subject Name	Code	Type of course	T-P-P	Prerequisite
INORGANIC CHEMISTRY	BSCH2401	•Theory & Lab	4-2-0	

Objective

- The chemistry Hons student study the syllabus and those who have already knew the basic of coordination chemistry, bioinorganic chemistry.

Learning outcome

- This course gives total idea about the coordination chemistry and its application towards biological system.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test		Written examination
	Assignment	*30*	Report and Presentation
	Experiments	*20*	Lab work, report
	Project		Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		*50(20+30)*	Written examination
Total		*100*	

Course Outline

Module-I (5 Hrs.)

Coordination Chemistry-1:
Werner's theory, valence bond theory (inner and outer orbital complexes), electroneutrality principle and back bonding.

Module-II (5 Hrs.)
Coordination Chemistry-2:
Crystal field theory, measurement of 10 Dq (Ao), CFSE in weak and strong fields, pairing energies, factors affecting the magnitude of 10 Dq (Ao, At). Octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry Jahn-Teller theorem, square planar geometry. Qualitative aspect of Ligand field and MO Theory.

Module-III (5 Hrs.)

Coordination Chemistry-3:
IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with 4 and 6 coordination numbers. Chelate effect, polynuclear complexes, Labile and inert complexes.

Module-IV (10 Hrs.)

Transition Elements:
General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, ability to form complexes. Stability of various oxidation states and e.m.f. (Latimer & Bsworth diagrams). Difference between the first, second and third transition series. Chemistry of Ti, V, Cr Mn, Fe and Co in various oxidation states (excluding their metallurgy)

Module-V (5 Hrs.)

Lanthanoids and Actinoids:
Electronic configuration, oxidation states, colour, spectral and magnetic properties, lanthanide contraction, separation of lanthanides (ion-exchange method only).

Module-VI (10 Hrs.)

Bioinorganic Chemistry-1:
Metal ions present in biological systems, classification of elements according to their action in biological system. Geochemical effect on the distribution of metals. Sodium / K-pump, carbonic anhydrase and carboxy peptidase. Excess and deficiency of some trace metals. Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, Use of chelating agents in medicine.

Module-VII (5 Hrs.)
Bioinorganic Chemistry-2:
Iron and its application in bio-systems, Haemoglobin; Storage and transfer of iron.

Recommended Books:

1. Purcell, K.F & Kotz, J.C. *Inorganic Chemistry* W.B. Saunders Co, 1977.
2. Huheey, J.E., *Inorganic Chemistry*, Prentice Hall, 1993.
3. Lippard, S.J. & Berg, J.M. *Principles of Bioinorganic Chemistry* Panima Publishing Company 1994.
4. Cotton, F.A. & Wilkinson, G, *Advanced Inorganic Chemistry* Wiley-VCH, 1999
5. Basolo, F, and Pearson, R.C. *Mechanisms of Inorganic Chemistry*, John Wiley & Sons, NY, 1967.
6. Greenwood, N.N. & Earnshaw A. *Chemistry of the Elements*, Butterworth-Heinemann, 1997.

Inorganic Chemistry Practice

Gravimetric Analysis:
1. Estimation of Nickel(II) using Dimethylglyoxime(DMG)
2. Estimation of Iron as Fe_2O_3 by precipitating as $Fe(OH)_3$
3. Estimation of Al(III) by precipitating with oxine and weighing as $Al(Oxine)_3$(Alluminium oxinate)

Inorganic Preparation:
1. Tetra amine copper(II) sulphate ,$[Cu(NH_3)_4]SO_4.H_2O$
2. Tetraaminecarbonatocobalt(III)ion

Chromatography metal ions:
Principles involved in chromatographic separation. Paper Chromatographic separation of following

metal ions:Ni(II) and Co(II) ,Fe(III) and Al(III)
Recommended Books:

Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.

BSCH2402 Organic Chemistry-III

Subject Name	Code	Type of course	T-P-P	Prerequisite
ORGANIC CHEMISTRY-III	BSCH2402	•Theory & Lab	4-2-0	

Objective

- To know the various nitro compound and its derivative for organic synthesis
- To identify the functional group and its application in organic reaction mechanism

Learning outcome

- able to recall the reagents and conditions for the reaction of nitriles towards acid hydrolysis
- able to recall the reagents and conditions for the reaction of nitriles towards reducing agents
- able to recall the reagents and conditions for the reaction of amides with phosphorus(V) oxide

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test		Written examination
	Assignment	*30*	Report and Presentation
	Experiments	*20*	Lab work, report
	Project		Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		*50(20+30)*	Written examination
Total		*100*	

Course Outline

Module-I (12 Hrs.)

Nitrogen Containing Functional Groups:

Preparation and important reactions of nitro and compounds, nitriles and isonitriles Amines: Effect of substituent and solvent on basicity; Preparation and properties: Gabriel phthalimide synthesis, Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction; Distinction between 1°, 2° and 3°amines with Hinsberg reagent and nitrous acid.Diazonium Salts: Preparation and their synthetic applications.

Module-II (8 Hrs.)

Polynuclear Hydrocarbons:
Reactions of naphthalene phenanthrene and anthracene Structure, Preparation and structure elucidation and important derivatives of naphthalene and anthracene; Polynuclear hydrocarbons.

Module-III (7 Hrs.)

Heterocyclic Compounds-1:
Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered rings containing one heteroatom; Synthesis, reactions and mechanism of substitution reactions of: Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis).

Module-IV (8 Hrs.)

Heterocyclic Compounds-2:
Thiophene, Pyridine (Hantzsch synthesis), Pyrimidine, Structure elucidation of indole, Fischer indole synthesis and Madelung synthesis), Structure elucidation of quinoline and isoquinoline, Skraup synthesis, Friedlander's synthesis, Knorr quinoline synthesis, Doebner- Miller synthesis, Bischler-Napieralski reaction, Pictet-Spengler reaction, Pomeranz-Fritsch Reaction .Derivatives of furan: Furfural and furoic acid.

Module-V (4 Hrs.)

Alkaloids-1:
Natural occurrence, General structural features, Isolation and their physiological action Hoffmann's exhaustive methylation, Emde's modification.

Module-VI (3 Hrs.)

Alkaloids-2:
Structure elucidation and synthesis of Hygrine and Nicotine. Medicinal importance of Nicotine, Hygrine, Quinine, Morphine, Cocaine, and Reserpine.

Module-VII (3 Hrs.)

Alkaloids-3: Terpenes:

Occurrence, classification, isoprene rule; Elucidation of structure and synthesis of Citral, Neral and a- terpineol.

Books:
1. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India)Pvt. Ltd.

(Pearson Education).
2. Finar, I. L. *Organic Chemistry (Volume* 1), Dorling Kindersley (India) Pvt. Ltd.(Pearson Education).
3. *Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).*
4. *Acheson, R.M. Introduction to the Chemistry of Heterocyclic compounds, John Welly & Sons (1976).*
5. Graham Solomons, T.W. *Organic Chemistry,* John Wiley & Sons, Inc.
6. McMurry, J.E. *Fundamentals of Organic Chemistry,* 7th Ed. Cengage Learning India Edition, 2013.
7. Kalsi, P. S. *Textbook of Organic Chemistry 1st Ed.*, New Age International (P) Ltd. Pub.
8. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; *Organic Chemistry*, Oxford University Press.
9. Singh, J.; Ali, S.M. & Singh, J. *Natural Product Chemistry,* Pragati Parakashan (2010).

Organic Chemistry Practice

1. Detection of extra elements.
2. Functional group test for nitro, amine, amide groups
3. Qualitative analysis of unknown organic compounds containing simple functional groups (alcohol, Carboxylic acids, phenols and carbonyl compounds)

Recommended Books:

1. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Pearson Education (2009)
2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.*, Pearson (2012)
3. *Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry:Preparation and Quantitative Analysis, University Press (2000).*
4. *Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry:Qualitative Analysis, University Press (2000).*

BSCH2403 Physical Chemistry-IV

Nomenclature

Subject Name	Code	Type of course	T-P-P	Prerequisite
Physical Chemistry-IV	BSCH2403	•Theory •Lab	4-2-0	Conductance Electrochemistry Electrical & Magnetic Properties of Atoms and Molecules

Objective

- the relationship between electricity, as a measurable and quantitative phenomenon, and identifiable chemical change, with either electricity considered an outcome of a particular chemical change or vice versa

- These reactions involve electric charges moving between electrodes and an electrolyte (or ionic species in a solution). Thus electrochemistry deals with the interaction between electrical energy and chemical change
- in simple electrolytic cells resulted from chemical action and that chemical combination occurred between substances of opposite charge

Learning outcome

- After completion of the course, students will able to understand regarding

primary cell which solved the problem of polarization by eliminating hydrogen gas generation at the positive electrode

- How the characteristics of the current produced could be used to calculate the free energy change in the chemical reaction producing the current.

Course outline

Module-1 (6 Hrs)

Conductance:

Arrhenius theory of electrolytic dissociation. Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Molar conductivity at infinite dilution. Kohlrausch law of independent migration of ions. Debye-Huckel-Onsager equation.

Module-II(6 Hrs)

Conductance

Wien effect, Debye-Falkenhagen effect, Walden's rules.Ionic velocities, mobilities and their determinations, transference numbers and their relation to ionic mobilities, determination of transference numbers using Hittorf and Moving Boundary methods.

Module-III(5 Hrs)

Conductance

Applications of conductance measurement: (i) degree of dissociation of weak electrolytes, (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts, (iv) conductometric titrations, and (v) hydrolysis constants of salts.

Module-IV (8 Hrs.)

Electrochemistry :I

Quantitative aspects of Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials, applications of electrolysis in metallurgy and industry. Chemical cells, reversible and irreversible cells with examples. Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells.

Module-V (8 Hrs.)

Electrochemistry :II

Application of EMF measurements in determining (i) free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, using hydrogen, quinone-hydroquinone, glass and SbO/Sb_2O_3 electrodes. Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transference numbers. Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation).

Module-VI (5 Hrs.)

Electrical & Magnetic Properties of Atoms and Molecules:
Basic ideas of electrostatics, Electrostatics of dielectric media, Clausius-Mosotti equation, Lorenz-Laurentz equation,

Module-VII (5 Hrs.)

Electrical & Magnetic Properties of Atoms and Molecules Properties and Application:
Dipole moment and molecular polarizabilities and their measurements. Diamagnetism, paramagnetism, magnetic susceptibility and its measurement, molecular interpretation.

Recommended Books:

1. Atkins, P.W & Paula, J.D. *Physical Chemistry,* 10th Ed., Oxford University Press (2014).
2. Castellan, G. W. *Physical Chemistry 4th Ed.,* Narosa (2004).
3. Mortimer, R. G. *Physical Chemistry 3rd Ed.,* Elsevier: NOIDA, UP (2009).
4. Barrow, G. M., *Physical Chemistry 5th Ed.,* Tata McGraw Hill: New Delhi (2006).
5. Engel, T. & Reid, P. *Physical Chemistry 3rd Ed.,* Prentice-Hall (2012).
6. Rogers, D. W. *Concise Physical Chemistry* Wiley (2010).
7. Silbey, R. J.; Alberty, R. A. & Bawendi, M. G. *Physical Chemistry 4th Ed.,* John Wiley & Sons, Inc. (2005).

Physical Chemistry Practice

Conductometry

1. Determination of cell constant
2. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.
3. Perform the following conductometric titration
   - I. Strong acid and strong base
   - II. Weak acid and strong base
   - III. Mixture of strong acid and weak acid vs strong base
   - IV. Strong acid vs. weak base
4. Potentiometric

   Perform the following potentiometric titration I. Strong acid vs. strong base
   - II. Weak acid Vs. strong base
   - III. Dibasic acid Vs. Strong base

Recommended Books:
1. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* S. Chand & Co.: New Delhi (2011).
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed.;* McGraw- Hill: New York (2003).
3. Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.;* W.H. Freeman & Co.: New York (2003).

BSCH3501Organic Chemistry-IV

Subject Name	Code	Type of course	T-P-P	Prerequisite
Organic Chemistry IV	BSCH3501	• Theory	4-2-0	

Objective

Key points: *Briefly explain what the course covers. Indicate why the course is to be studied. Specify who should study the course and requirement of prior knowledge and skill, if any.*

- The course structure gives idea about the different structure of different bases of nucleic acid, DNA and RNA.
- Number of amino acids, there functions and the peptide bond that connect di, tri and polypeptides.
- Function of proteins and recognize the importance of the three dimensional shape of a protein on its function and role of noncovalent bonds in maintaining the shape of a protein

Learning outcome

- After completion of the course, students will able to understand regarding the essential and nonessential amino acids and can predict how there ionic charges change with pH.
- They know how enzyme activity is regulated and affected by temperature, pH and concentration in biochemical reaction.
- It also learn about DNA replication, transcription and translation including the role of RNA.

Evaluation Systems

Internal Examination	*Component*	*% of Marks*	*Method of Assessment*

	Midterm Test	nil	Written examination
	Assignment	30	Report and Presentation
	Experiments	20	nil
	Project	nil	nil
	Quiz	nil	nil
External Examination		50(20+30)	Written examination
Total		100	

Course outline

Module-I (6 Hrs.)
Nucleic Acids:
Components of nucleic acids, Nucleosides and nucleotides; Structure, synthesis and reactions of: Adenine, Guanine, Cytosine, Uracil and Thymine; Structure of polynucleotides.

Module-II (5 Hrs.)
Amino Acids:
Amino Acids, Peptides and Proteins
Amino acids, Peptides and their classification.a-Amino Acids - Synthesis, ionic properties and reactions. Zwitterions, *pKa* values, isoelectric point and electrophoresis.

Module-III (5 Hrs.)

Peptides:
Study of peptides methods of peptide synthesis. Synthesis of peptides using N-protecting, C-protecting and C-activating groups -Solid-phase synthesis

Module-IV (10 Hrs.)

Enzymes:
Introduction, classification and characteristics of enzymes. Salient features of active site of enzymes. Mechanism of enzyme action (taking trypsin as example), factors affecting enzyme action, coenzymes and cofactors and their role in biological reactions, specificity of enzyme action (including stereospecificity), enzyme inhibitors and their importance, phenomenon of inhibition (competitive, uncompetitive and noncompetitive inhibition including allosteric inhibition).

Module-V(5 Hrs.)

Lipids:
Introduction to oils and fats; common fatty acids present in oils and fats, Hydrogenation of fats and oils, Saponification value, acid value, iodine number.

Module-VI (8 Hrs.)

Concept of Energy in Biosystems:
Introduction to metabolism (catabolism, anabolism. ATP: The universal currency of cellular energy, ATP hydrolysis and free energy change.Agents for transfer of electrons in biological redox systems: NAD+, FAD. Outline of catabolic pathways of carbohydrate- glycolysis,fermentation, Krebs cycle.

Module-VII (7 Hrs.)

Pharmaceutical Compounds:
Pharmaceutical Compounds: Structure and Importance,Classification, structure and therapeutic uses of antipyretics: Paracetamol (with synthesis), Analgesics: Ibuprofen (with synthesis), Antimalarials: Chloroquine (with synthesis). An elementary treatment of Antibiotics and detailed study of chloramphenicol, Medicinal values of curcumin (haldi), azadirachtin (neem), vitamin C and antacid (ranitidine).

Recommended Books:

1. Berg, J.M., Tymoczko, J.L. & Stryer, L. (2006) *Biochemistry.* 6th Ed. W.H. Freeman and Co.
2. Nelson, D.L., Cox, M.M. & Lehninger, A.L. (2009) *Principles of Biochemistry. IV*
3. *Edition.* W.H. Freeman and Co.
4. Murray, R.K., Granner, D.K., Mayes, P.A. & Rodwell, V.W. (2009) *Harper's Illustrated Biochemistry.* XXVIII edition. Lange Medical Books/ McGraw-Hill.

Organic Chemistry Lab (2 Credit)
1. Estimation of glycine by Sorenson's formalin method.
2. Study of the titration curve of glycine.
3. Estimation of proteins by Lowry's method.
4. Study of the action of salivary amylase on starch at optimum conditions.
5. Effect of temperature on the action of salivary amylase.
6. Saponification value of an oil or a fat.
7. Determination of Iodine number of an oil/ fat.
8. Isolation and characterization of DNA from onion/ cauliflower/peas.

Reference Books:

1. Manual of Biochemistry Workshop, 2012, Department of Chemistry, University of Delhi.
2. Arthur, I. V. Quantitative Organic Analysis, Pearson.

BSCH3502 Physical Chemistry-V

SubjectName	Code	Type of course	T-P-P	Prerequisite
Physical Chemistry-V	BSCH3502	•Theory & Lab	4-2-0	

Objective

- To impart knowledge regarding different quantum mechanical principles and their application to microscopic phenomena.
- To understand the covalent nature of bonding and their mathematical back ground.

- Access basic knowledge to different spectroscopic techniques and photochemistry

Learning outcome

- Understand the concepts of quantum chemistry and their application to microscopic entities and will be able to differentiate between classical and quantum mechanics.
- Understand the concepts of covalent bonding between atoms, their stability.
- Know basic concepts of different spectroscopic techniques like microwave, vibrational spectroscopy, NMR and Raman, and their application as well as interpretation to chemical compounds.
- Gain sound knowledge of photochemistry, different laws governing and kinetic of different photophysical and chemical phenomenon.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test	*20*	Written examination
	Assignment	*10*	Report and Presentation
	Experiments	*20*	Lab work, report
	Project	-	Report and presentation
	Quiz	-	Surprise/preannounced ones
External Examination		*50*	Written examination
Total		*100*	

Course outline

Module-I **(8 Hrs.)**

Quantum Chemistry

Postulates of quantum mechanics, quantum mechanical operators, Schrodinger equation and its application to free particle and "particle-in-a-box" (rigorous treatment), quantization of energy levels, zero-point energy and Heisenberg Uncertainty principle; wavefunctions, probability distribution functions, nodal properties, Extension to two and three dimensional boxes, separation of variables, degeneracy. Qualitative treatment of simple harmonic oscillator model of vibrational motion: Setting up of Schrodinger equation and discussion of solution and wavefunctions. Vibrational energy of diatomic molecules and zero-point energy.

Module-II **(7 Hrs.)**

Chemical bonding: 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 H2 (only wavefunctions, detailed solution not required) and their limitations. Refinements of the two approaches (Configuration Interaction for MO, ionic terms in VB). Qualitative description of LCAO-MO treatment of homonuclear and heteronuclear diatomic molecules (HF, LiH).

Module-III **(4 Hrs.)**

Molecular Spectroscopy:

Interaction of electromagnetic radiation with molecules and various types of spectra; Born-Oppenheimer approximation. Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution.

Module-IV **(6 Hrs.)**

Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies. Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches.

Module-V **(4 Hrs.)**

Raman spectroscopy: Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines;

Module-VI **(6 Hrs.)**

Nuclear Magnetic Resonance (NMR) spectroscopy: Principles of NMR spectroscopy, Larmor precession, chemical shift and low resolution spectra, different scales, spin-spin coupling and high resolution spectra, interpretation of PMR spectra of organic molecules.

Module-VII **(8 Hrs.)**

Photochemistry

Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws, of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitised reactions, quenching. Role of photochemical reactions in biochemical processes, photostationary states, chemiluminescence.

Recommended Books:

1. Banwell, C. N. & McCash, E. M. *Fundamentals of Molecular Spectroscopy* 4th Ed. Tata McGraw-Hill: New Delhi (2006).

- Chandra, A. K. *Introductory Quantum Chemistry* Tata McGraw-Hill (2001).
- House, J. E. *Fundamentals of Quantum Chemistry* 2nd Ed. Elsevier: USA (2004).
- *Kakkar, R. Atomic & Molecular Spectroscopy: Concepts & Applications, Cambridge University Press (2015).*
- Lowe, J. P. & Peterson, K. *Quantum Chemistry,* Academic Press (2005).

Physical Chemistry Practice

1. Study the 200-500 nm absorbance spectra of KMnO4 and K2Cr2O7 (in 0.1 M H2SO4) and determine the λmax values. Calculate the energies of the two transitions in different units (J molecule-1, kJ mol-1, cm-1, eV).
2. Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of K2Cr2O7.

3. Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde,2-propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of organic compounds.
4. Verify Lambert-Beer's law and determine the concentration ofCuSO4/KMnO4/K2Cr2O7 in a solution of unknown concentration by colorimetry
5. Determine the concentrations of KMnO4 and K2Cr2O7 in a mixture.
6. Study the kinetics of iodination of propanone in acidic medium.
7. Determine the amount of iron present in a sample using 1,10-phenathroline.
8. Determine the dissociation constant of an indicator (phenolphthalein).
9. Study the kinetics of interaction of crystal violet/ phenolphthalein with sodium hydroxide.
10. Viscosity measurement using Ostwald's viscometer.
    a. Determination of viscosity of aqueous solutions of (i) ethanol and sugar solution at room temperature

    b . Study the variation of viscosity of sucrose solution with the concentration of solute

Recommended Books:

1. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed.;* McGraw-Hill: New York (2003).
3. Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.;* W.H. Freeman & Co.: New York (2003).

BSCH3601 Inorganic Chemistry-IV

Subject Name	Code	Type of course	T-P-P	Prerequisite
Inorganic Chemistry-IV	BSCH3601	Theory & Lab	4-2-0	

Objective

- To have a basic knowledge of: Organometallic Chemistry. Metal carbonyls, hydrocarbon and carbocyclic ligands, 18-electron rule (saturation and unsaturation), synthesis and properties, patterns of reactivity (substitution, oxidative-addition and reductiveelimination, insertion and de-insertion, nucleophilic attack on ligands,

isomerization, stereochemicalnonrigidity)

Learning outcome

Having complete the course you should:

• have a good overview of the fundamental principles of organotransition-metal chemistry and know how chemical properties are affected by metals and ligands.

• be able to use knowledge about structure and bonding issues to understand the stability and reactivity of simple organometallic complexes.

• have insight into the use of modern methods to characterize organometallic compounds.

• understand fundamental reaction types and mechanisms and how to combine these to understand efficient catalytic processes

• know important applications of organometallic homogeneous catalysis in the production of large-scale (bulk) and smaller-scale (fine chemicals) production.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test		Written examination
	Assignment	*30*	Report and Presentation
	Experiments	*20*	Lab work, report
	Project		Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		*50*	Written examination
Total		*100*	

Course Outline

Module-I (8 Hrs.)

Theoretical Principles in Qualitative Analysis (H2S Scheme)
Basic principles involved in analysis of cations and anions and solubility products, common ion effect. Principles involved in separation of cations into groups and choice of group reagents. Interfering anions (fluoride, borate, oxalate and phosphate) and need to remove them after Group II.

Module-II (5 Hrs.)

Organometallic Compounds
Definition and classification of organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands. Metal carbonyls: 18 electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series.

Module-III (5Hrs.)

General methods of preparation (direct combination, reductive carbonylation, thermal and photochemical decomposition) of mono and binuclear carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT. Pi-acceptor behaviour of CO (MO diagram of CO to be discussed), synergic effect and use of IR data to explain extent of back bonding.

Module-IV (5Hrs.)

Zeise's salt: Preparation and structure, evidences of synergic effect and comparison of synergic effect with that in carbonyls. Metal Alkyls: Important structural features of methyl lithium (tetramer) and trialkyl aluminium (dimer), concept of multicentre bonding in these compounds. Role of triethylaluminium in polymerisation of ethene (Ziegler - Natta Catalyst). Ferrocene: Preparation and reactions (acetylation, alkylation, metallation, Mannich Condensation). Structure and aromaticity. Comparison of aromaticity and reactivity with that of benzene.

Module-V (4 Hrs.)

Reaction Kinetics and Mechanism

Introduction to inorganic reaction mechanisms. Substitution reactions in square planar complexes, Transeffect, theories of trans effect, Mechanism of nucleophilic substitution in square planar complexes,

Module-VI(5Hrs.)

Thermodynamic and Kinetic stability, Kinetics of octahedral substitution ,Ligand field effects and reaction rates, Mechanism of substitution in octahedral complexes.Catalysis by Organometallic Compounds

Module-VII(Hrs.)

Study of the following industrial processes and their mechanism:

1. Alkene hydrogenation (Wilkinsons Catalyst)
2. Hydroformylation (Co salts)
3. Wacker Process
4. Synthetic gasoline (Fischer Tropsch reaction)

Recommended Books:

1. Svehla, G. Vogel's Qualitative Inorganic Analysis, 7th Edition, Prentice Hall, 1996.
2. Cotton, F.A.G.; Wilkinson & Gaus, P.L. Basic Inorganic Chemistry 3rd Ed.; Wiley India,
3. Huheey, J. E.; Keiter, E.A. & Keiter, R.L. Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed., Harper Collins 1993, Pearson,2006.
4. Sharpe, A.G. Inorganic Chemistry, 4th Indian Reprint (Pearson Education) 2005
5. Douglas, B. E.; McDaniel, D.H. & Alexander, J.J. Concepts and Models in Inorganic Chemistry3rd Ed., John Wiley and Sons, NY, 1994.
6. Greenwood, N.N. & Earnshaw, A. Chemistry of the Elements, Elsevier 2nd Ed, 1997 (Ziegler Natta Catalyst and Equilibria in Grignard Solution).
7. Lee, J.D. Concise Inorganic Chemistry 5th Ed., John Wiley and sons 2008.
8. Powell, P. Principles of Organometallic Chemistry, Chapman and Hall, 1988.

9. Shriver, D.D. & P. Atkins, Inorganic Chemistry 2nd Ed., Oxford University Press, 1994.
10. Basolo, F. & Pearson, R. Mechanisms of Inorganic Reactions: Study of Metal Complexes in Solution 2nd Ed., John Wiley & Sons Inc; NY.
11. Purcell, K.F. & Kotz, J.C., Inorganic Chemistry, W.B. Saunders Co. 1977
12. Miessler, G. L. & Tarr, D.A. Inorganic Chemistry 4th Ed., Pearson, 2010.

Inorganic Chemistry Practice

Qualitative semimicro analysis of mixtures containing 3 anions and 3 cations. Emphasis should be given to the understanding of the chemistry of different reactions. The following radicals are suggested: CO_3^{2-}, NO_2^-, S_2^-, SO_3^{2-},$S_2O_3^{2-}$, CH_3COO^-, F^-,Cl^-, Br^-, I^-, NO_3^-, BO_3^{3-}, $C_2O_4^{2-}$, PO_4^{3-}, NH_4^+, K^+,

Pb^{2+}, Cu^{2+}, Cd^{2+}, Bi^{3+}, Sn^{2+}, Sb^{3+}, Fe^{3+}, Al^{3+}, Cr^{3+}, Zn^{2+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Ba^{2+},Sr^{2+}, Ca^{2+},

Mg^{2+} Mixtures should preferably contain one interfering anion, or insoluble component ($BaSO_4$, $SrSO_4$, $PbSO_4$, CaF_2 or Al_2O_3) or combination of anions e.g. CO_3^{2}" and SO_3^{2}", NO_2" and NO_3",Cl" and Br", Cl" and I", Br" and I", NO_3" and Br", NO_3" and I".

Spot tests should be done whenever possible.

ii.Controlled synthesis of two copper oxalate hydrate complexes: kinetic vs. thermodynamic factors.

iii. Preparation of acetylacetanato complexes of Cu2+/Fe3+. Find the ^max of the complex

Recommended Books:

1. Vogel's Qualitative Inorganic Analysis, Revised by G. Svehla. Pearson Education, 2002.
2. Marr & Rockett Practical Inorganic Chemistry. John Wiley & Sons 1972.

BSCH3602 Organic Chemistry-V

Subject Name	Code	Type of course	T-P-P	Prerequisite
Inorganic Chemistry-IV	BSCH3601	Theory & Lab	4-2-0	

Objective

- to learn proper sample handling procedures for acquiring infrared **spectra**.
- to determine the percentage composition of a liquid sample mixture by the application of Beer's law.
- Recognize and draw particular carbohydrate structures
- Know general structural elements of cyclic monosaccharides and disaccharides, and their implications for structure/function
- Predict the products of condensation reactions and hydrolysis

Learning outcome

- Explain what it means to use spectroscopic methods for qualitative and quantitative analysis.
- Identify the terms in and describe deviations to Beer's Law.
- Describe the effect of changing the slit width and the impact it will have on qualitative and quantitative analyses
- Describe/recognize amino acid structures, describe their physical and chemical properties, and predict how their ionic charges change with pH.
- Define primary, secondary, tertiary and quaternary structure in proteins and identify the types of interactions important in each case.
- Describe the chemical nature of enzymes and their function in biochemical reactions.
- Explain what happens during digestion of proteins, catabolism of amino acids and the urea cycle.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test		Written examination
	Assignment	*30*	Report and Presentation
	Experiments	*20*	Lab work, report
	Project		Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		*50*	Written examination
Total		*100*	

Course outline

Module-I (6 Hrs.)

Organic Spectroscopy

General principles Introduction to absorption and emission spectroscopy. UV Spectroscopy: Types of electronic transitions, Tmax, Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward rules for calculation of ^max for the following systems: a,P unsaturated aldehydes, ketones, carboxylic acids and esters; Conjugated dienes: alicyclic, homoannular and heteroannular; Extended conjugated systems (aldehydes, ketones and dienes); distinction between cis and trans isomers.

Module-II (3Hrs.)

IR Spectroscopy: Fundamental and non-fundamental molecular vibrations; IR absorption positions of O, N and S containing functional groups; Effect of H"bonding, conjugation, resonance and ring size on IR absorptions; Fingerprint region and its significance; application in functional group analysis.

Module-III(5Hrs.)

NMR Spectroscopy: Basic principles of Proton Magnetic Resonance, chemical shift and factors influencing it; Spin - Spin coupling and coupling constant; Anisotropic effects in alkene, alkyne, aldehydes and aromatics, Interpretation of NMR spectra of simple compounds. Applications of IR, UV and NMR for identification of simple organic molecules.

Module-IV (5 Hrs.)

Carbohydrates,Occurrence, classification and their biological importance. Monosaccharides: Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures; Interconversions of aldoses and ketoses; Killiani-Fischer synthesis and Ruff degradation; Disaccharides - Structure elucidation of maltose, lactose and sucrose.Polysaccharides: starch, cellulose and glycogen.

Module-V (7 Hrs.)

Dyes:Classification, Colour and constitution; Mordant and Vat Dyes; Chemistry of dyeing; Synthesis and applications of: Azo dyes - Methyl Orange and Congo Red (mechanism of Diazo Coupling); Triphenyl Methane Dyes -Malachite Green, Rosaniline and Crystal Violet; Phthalein Dyes - Phenolphthalein and Fluorescein; Natural dyes -structure elucidation and synthesis of Alizarin and Indigotin; Edible Dyes with examples.

Mudule-VI(7Hrs.)

Polymers Introduction and classification including di-block, tri-block and amphiphilic polymers; Number average molecular weight, Weight average molecular weight, Degree of polymerization, Polydispersity Index. Polymerisation reactions -Addition and condensation -Mechanism of cationic, anionic and free radical addition polymerization;

Module-VII(5Hrs.)

Metallocene-based Ziegler-Natta polymerisation of alkenes; Preparation and applications of plastics - thermosetting (phenol-formaldehyde, Polyurethanes) and thermosoftening (PVC, polythene);Fabrics - natural and synthetic (acrylic, polyamido, polyester); Rubbers - natural and synthetic: Buna-S, Chloroprene and Neoprene; Vulcanization; Polymer additives; Introduction to liquid crystal polymers; Biodegradable and conducting polymers with examples.

Recommended Books:

1. Kalsi, P. S. Textbook of Organic Chemistry 1st Ed., New Age International (P)Ltd. Pub.
2. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India)Pvt. Ltd. (Pearson Education).
3. Billmeyer, F. W. Textbook of Polymer Science, John Wiley & Sons, Inc.4. Gowariker, V. R.; Viswanathan, N. V. & Sreedhar, J. Polymer Science, New Age International (P) Ltd. Pub.
4. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
5. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; Organic Chemistry, Oxford University Press.
6. Singh, J.; Ali, S.M. & Singh, J. Natural Product Chemistry, Prajati Prakashan (2010).

7. Kemp, W. Organic Spectroscopy, Palgrave.
8. Pavia, D. L. et al. Introduction to Spectroscopy 5th Ed. Cengage Learning India Ed. (2015).

Organic Chemistry Practice

1. Extraction of caffeine from tea leaves.
2. Preparation of urea formaldehyde.
3. Analysis of Carbohydrate: aldoses and ketoses, reducing and non-reducing sugars.
4. Qualitative analysis of unknown organic compounds containing monofunctional groups carbohydrates, aryl halides, aromatic hydrocarbons, nitro compounds, amines and amides) and simple bifunctional groups, for e.g. salicylic acid, cinnamic acid, nitrophenols etc.
5. Identification of simple organic compounds by IR spectroscopy and NMR spectroscopy (Spectra to be provided).
6. Preparation of methyl orange.

Recommended Books:

1. Vogel, A.I. Quantitative Organic Analysis, Part 3, Pearson (2012).
2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
3. Fumiss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012)
4. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000).
5. Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press (2000).

Basket-2

Ability Enhancement Compulsory Course (AECC)

BSFL1101 ENGLISH

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
ENGLISH	**BSFL1101**	**Theory**	**2-0-0**	**Nil**

Objective

- To expose the students to a variety of self- instructional, learner- friendly modes of language learning.
- To enable them to learn better pronunciation through stress on word accent, intonation, and rhythm.
- To maintain good linguistic - through accuracy in grammar, pronunciation and vocabulary.

Learning Outcome

- Ability to communicate fluently in different business situation
- Effective oral and written communication
- Appropriate word usage with correct pronunciation
- Clarity of word stress and intonation.

Evaluation Systems

	Component	***% of Marks***	***Method of Assessment***
Internal Examination	Midterm Test	*30*	Written examination
	Assignment	*05*	Report and Presentation
	Attendance	*05*	Attendance percentage
	Total	***40***	
External Examination		***60***	Written examination
Total		*100*	

Course Outline

Module-I: Communication Skill

Communication: Definition, concept

Channels of Communication: Sender, receiver, channel, message, encoding, decoding, context, feedback

Verbal & Non-Verbal Communication: Spoken & written-advantages & disadvantages, Bias free English,

Formal & informal style.

Module-II: Communicative Grammar

Time, Tense & Aspect

Verbs of state & events

Modality

Active & Passive voice

Antonyms, Synonyms, Homonyms, one word substitutions & correction of errors

Module-III: Sounds of English

Length of vowels:

Long vowels as in the words feel, food, shoot, card etc.

Short vowels as in the words pen, sun, cut, shut, etc.

Consonants

Stress pattern

Intonation: Rising & Falling.

Text Book:

1. Effective technical communication by M.A.Rizvi

Reference Books:

1. Communicative English & Business Communication by R.K.Panda, J.Khuntia, M.Pati, Alok Publication.
2. Communicative Grammar of English Geoffery Leech

FCBS0101 ENVIRONMENTAL SCIENCE

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
ENVIRONMENTAL SCIENCE	**FCBS0101**	**Theory**	**2-0-0**	**Nil**

Objective

- To understand the concept of multi-disciplinary nature of Environmental Science where different aspects are dealt with a holistic approach.
- Students will develop a sense of community responsibility by becoming aware of environmental issues in the larger social context.
- One must be environmentally educated.

Learning Outcome

Upon successful completion of this course, students will be able to:

- Understand the natural environment and its relationships with human activities.
- Characterize and analyze human impacts on the environment.
- Integrate facts, concepts, and methods from multiple disciplines and apply to environmental problems.
- Design and evaluate strategies, technologies and methods for sustainable management of environmental systems and for the remediation or restoration of degraded environments.

Evaluation Systems

	Component	***% of Marks***	***Method of Assessment***
Internal Examination	Midterm Test	*30*	Written examination
	Assignment	*05*	Report and Presentation
	Attendance	*05*	Attendance percentage
	Total	***40***	
External Examination		***60***	Written examination
Total		*100*	

Course Outline

MODULE-I

Environment and its multidisciplinary nature; Need for public awareness; Renewable and non - renewable resources–forest, water, mineral, land, food and energy resources; Structure and function of ecosystems of forest, grass land, desert and aquatic types.

MODULE -II

Biodiversity and its conservation: Biodiversity at global, national and local levels; Threats to biodiversity - Habitat loss; wild life poaching and man - wildlife conflicts; Endangered and endemic species; conservation measures.

Causes, effects and control measures of pollution, air, water and noise pollution; Nuclear hazards; solid-waste management–Causes, effects and control measures; Management of disasters due to natural causes of floods, earthquakes, cyclones and landslides.

MODULE-III

Social issues and the environment; Sustainable environment, Water conservation measures; Rain water harvesting; Resettlement and rehabilitation of people; Climate change and global warming; Acid rain; Ozone layer depletion; water land reclamation; Consumerism and waste products; Features of Environment Protection Act, Air pollution and Control of Pollution Acts; Water Pollution and its Control Act. Effects of Pollution explosion on environment and public health; Need for value education to Protect environment and resources.

Text Book:

1. Anubhav Kaushik & C.P. Kaushik: Environmental Studies-New age International Publishers.

Reference Books:

1. Benny Joseph: Environmental Studies-Tata Mac Graw Hill
2. E. Bharucha: Text book of Environmental Studies for under graduate courses– Universities Press. (Book prepared by UGC Committee).

Basket-3+4

Domain / Non Domain Courses

Pharmaceutical Chemistry

DEPC0101-Basic Herbal Technology

Subject Name	Code	Type of course	T-P-P	Prerequisite
Basic Herbal Technology	DEPC0101	• Theory	2-0-0	Nil

Objective

- The course structure gives idea about the different sources of medicines and the methods of extraction.
- Pharmacognosy of drugs.
- Prerequirement:

Learning outcome

- After completion of the course, students will able to understand animal and vegetable sources of medicines and the ways of isolation.
- They will know the different ways of classification of drugs.
- It also learn about different systems of medicine like allopathy, ayurvedic, unani etc.

Evaluation Systems

Key points: State clearly the components, weights and methods of evaluation system.

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test	*30*	Written examination
	Assignment	*10*	Report and Presentation
	Experiments		Lab work, report
	Project		Report and presentation
	Quiz	*10*	Surprise/preannounced ones
External Examination		*60*	Written examination
Total		*100*	

Course outline

Module I **(9 Hrs)**

Introduction to Pharmacognosy:

Definition, history, scope and development of Pharmacognosy, Sources of Drugs – Plants, Animals, Marine & Tissue culture ,Organized drugs, unorganized drugs (dried latex, dried juices, dried extracts, gums and mucilages, oleoresins and oleo- gum -resins).

Module II **(8 Hrs)**

Classification of drugs:Alphabetical, morphological, taxonomical, chemical, pharmacological, chemo and sero taxonomical classification of drugs.

Module III **(8 Hrs)**

Pharmacognosy in various systems of medicine: Role of Pharmacognosy in allopathy and traditional systems of medicine namely, Ayurveda,Unani, Siddha, Homeopathy and Chinese systems of medicine.

Reference

Text Books:

1. Patrick, G. L. *Introduction to Medicinal Chemistry*, *Oxford University* Press, UK, 2013.

2. Singh, H. & Kapoor, V.K. *Medicinal and Pharmaceutical Chemistry*, Vallabh Prakashan, Pitampura, New Delhi, 2012.

Reference Books:

1. Foye, W.O., Lemke, T.L. & William, D.A.: *Principles of Medicinal Chemistry*, 4th ed., B.I. Waverly Pvt. Ltd. New Delhi.

DEPC0201- Extraction and Isolation of Drugs

Subject Name	**Code**	**Type of course**	**T-P-P**	**Prerequisite**
Extraction And Isolation of Drugs	DEPC0201	•Practice	0-2-0	Nil

Objective

- To impart practical knowledge regarding extraction and isolation chemical entities from animal and plant sources, which is important for students of pharmaceutical science
- Also it teaches chemical analysis of certain compounds of pharmaceutical importance.

Learning outcome

- Students will learn the different methods of extraction and isolation of plant and animal materials.
- They also gather ideas regarding how to analyse chemically certain biological compounds.
- It also teaches preparation of solutions of different concentration and pH.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test	*20*	Written examination
	Assignment	*20*	Report and Presentation
	Experiments	*60*	Lab work, report
	Project		Report and presentation
	Quiz		Surprise/preannounced ones
External Examination			Written examination
Total		*100*	

Course outline

1. Extraction of Plant materials
2. Isolation of Starch from Potato
3. Assay of Drug by Titrimetric Method
4. Qualitative analysis of carbohydrates (Glucose, Fructose, Lactose, Maltose,Sucrose and starch)
5. Preparation of buffer solution and measurement of pH

Reference

Text Books:

3. 1. Patrick, G. L. Introduction to Medicinal Chemistry, Oxford University Press, UK, 2013.
4. 2. Singh, H. & Kapoor, V.K. Medicinal and Pharmaceutical Chemistry, Vallabh Prakashan, Pitampura, New Delhi, 2012.

Reference Books:

2. Foye, W.O., Lemke, T.L. & William, D.A.: Principles of Medicinal Chemistry, 4th ed., B.I. Waverly Pvt. Ltd. New Delhi.

DEPC0202-Chemical identification of drugs

Subject Name	**Code**	**Type of course**	**T-P-P**	**Prerequisite**
Chemical identification of drugs	DEPC0202	• Lab	0-2-0	Nil

Objective

- Identify the physical properties of drugs
- Identify the group involved in the regulation of drug
- Identify the specific chemicals involved in the preparation of drug

Learning outcome

After learning the practice paper student can learn

- About the basic chemical test for the identification of drug
- Inorganic chemical present in a unknown drug sample

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test		Written examination
	Assignment	*30*	Report and Presentation
	Experiments	*70*	Lab work, report
	Project		Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		*0*	Written examination

Total		*100*	

Course outline

I. Limit tests for following ions Limit test for Chlorides and Sulphates
Modified limit test for Chlorides and Sulphates Limit test for Iron

1. Limit test for Heavy metals
2. Limit test for Lead
3. Limit test for Arsenic

II .Identification test Magnesium hydroxide

1. Ferrous sulphate
2. Sodium bicarbonate
3. Calcium gluconate
4. Copper sulphate

III. Test for purity Swelling power of Bentonite

1. Neutralizing capacity of aluminum hydroxide gel
2. Determination of potassium iodate and iodine in potassium Iodide

IV. Preparation of inorganic pharmaceuticals

1. Boric acid
2. Potash alum
3. Ferrous sulphate

Reference

Text Books:

5. A.H. Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I & II, Stahlone Press of University of London, 4 th edition.
6. A.I. Vogel, Text Book of Quantitative Inorganic analysis
7. P. Gundu Rao, Inorganic Pharmaceutical Chemistry, 3 rd Edition

Reference Books:

1. M.L Schroff, Inorganic Pharmaceutical Chemistry
2. Bentley and Driver's Textbook of Pharmaceutical Chemistry
3. Anand & Chatwal, Inorganic Pharmaceutical Chemistry

DEPC0401-Chemistry of Biomolecules

Subject Name	Code	Type of course	T-P-P	Prerequisite
Chemistry of Biomolecules	DEPC0401	•Theory & Lab	2-2-0	Must have covered basics of Organic chemistry-1 in 1st Year, B.Sc.

Objective

- To know the structure, stereochemistry and some basics of molecules like carbohydrates, lipids, proteins as well as some heterocyclic biomolecules.
- To understand the importance of biomolecules, their chemistry and working principles in living systems
- The course structure gives an outline idea of life sustaining biomolecules and their reactions in the living system.
- To the study the course the students must have basic knowledge in organic chemistry.

Learning outcome

After completion of the course,

- Students will understand the stereochemistry of biomolecules in living systems and their principles of reactivity.
- Understand the structures and chemistry of carbohydrates, proteins, and other heteroatomic systems.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test	*20*	Written examination
	Assignment	*10*	Report and Presentation
	Experiments	*20*	Lab work, report
	Project	-	Report and presentation
	Quiz	-	Surprise/preannounced ones
External Examination		*50 (ETR-30, EPR-20)*	Written examination
Total		*100*	

Course outline

Module-I **(15 Hrs)**

Stereo isomerism

Optical isomerism –Optical activity, enantiomerism, diastereoisomerism, meso compounds

Elements of symmetry, chiral and achiral molecules DL system of nomenclature of optical isomers, sequence rules, RS system of nomenclature of optical isomers Racemic modification and resolution of racemic mixture. Asymmetric synthesis: partial and absolute.

Geometrical isomerism:Nomenclature of geometrical isomers (Cis Trans, EZ, Syn Anti systems)

Methods of determination of configuration of geometrical isomers. Conformational isomerism in Ethane, n-Butane and Cyclohexane.Stereo isomerism in biphenyl compounds (Atropisomerism) and conditions for optical activity.Stereospecific and stereoselective reactions

Module-II **(8 Hrs)**

Chemistry of heterocyclic compounds :Nomenclature and classification, Synthesis, reactions and medicinal uses of following compounds/derivativesPyrrole, Furan, and Thiophene

Nomenclature, Structure and medicinal uses of following compounds/derivatives Pyrazole, Imidazole, Oxazole and Thiazole. Pyridine, Quinoline, Isoquinoline, Acridine and Indole. Medicinal uses of Pyrimidine, Purine, azepines and their derivatives.

Module-III **(7 Hrs)**

Introduction, classification, Chemical nature and biological role of carbohydrate, lipids, nucleic acids, amino acids and proteins.

Practice **Hour-20**

1. Preliminary test: Color, odour, aliphatic/aromatic compounds, saturation and unsaturation of organiccompounds.
2. Detection of elements like Nitrogen, Sulphur and Halogen by Lassaigne's test
3. Solubility test of unknown organic compounds
4. Functional group test like Phenols, Amides/ Urea, Carbohydrates, Amines, Carboxylic acids, Aldehydes and Ketones, Alcohols, Esters, Aromatic and Halogenated Hydrocarbons, Nitro compounds and Anilides.
5. Melting point/Boiling point of organic compounds
6. Identification of the unknown compound from the literature using melting point/ boiling point.
7. Preparation of the derivatives and confirmation of the unknown compound by melting point/ boiling point.
8. Preparation of suitable solid derivatives from organic compounds

Recommended Books (Latest Editions)

1. Organic Chemistry by Morrison and Boyd
2. Organic Chemistry by I.L. Finar , Volume-I
3. Textbook of Organic Chemistry by B.S. Bahl & Arun Bahl.
4. Organic Chemistry by P.L.Soni
5. Practical Organic Chemistry byMann and Saunders.
6. Vogel's text book of Practical Organic Chemistry
7. Advanced Practical organic chemistry by N.K.Vishnoi.
8. Introduction to Organic Laboratory techniques by Pavia, Lampman and Kriz.

9. Reaction and reaction mechanism by Ahluwaliah/ Chatwal.

DEPC0402-Physical Chemistry of Pharmaceuticals

Subject Name	Code	Type of course	T-P-P	Prerequisite
Physical Chemistry of Pharmaceuticals	DEPC0402	•Theory & Lab	2-2-0	Nil

Objective

- The course structure discusses about the history of medicines and physico-chemical properties and behavior of chemical compounds in solutions.
- It also discusses important laws of physical chemistry so as to predict the spontaneity of different processes

Learning outcome

- Students will understand different physico-chemical properties pertaining to biological actions.
- They will also learn mechanism of solute solvent interactions and laws governing these principles.
- They will also learn the optical, electrical, kinetic properties of colloidal dispersion in solution.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test	*20*	Written examination
	Assignment	*10*	Report and Presentation
	Experiments	*20*	Lab work, report

	Project		Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		*50*	Written examination
Total		*100*	

Course outline

Module-I **(15 Hrs)**

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.

Solubility of drugs: Solubility expressions, mechanisms of solute solvent interactions, Ideal solubility parameters, solvation & association, quantitative approach to the factors influencing solubility of drugs, diffusion principles in biological systems. Solubility of gas in liquids, Solubility of liquids in liquids, (Binary solutions, ideal solutions) Raoult's law, real solutions. Partially miscible liquids, Critical solution temperature and applications. Distribution law, its limitations and applications

Module-II **(8 Hrs)**

Colloidal dispersions: Classification of dispersed systems & their general characteristics, size & shapes of colloidal particles, classification of colloids & comparative account of their general properties. Optical, kinetic & electrical properties. Effect of electrolytes, coacervation, peptization & protective action.

Module-III **(7 Hrs)**

pH, buffers and Isotonic solutions: Sorensen's pH scale, pH determination (electrometric and calorimetric), applications of buffers, buffer equation, buffer capacity, buffers in pharmaceutical and biological systems, buffered isotonic solutions.

Practice Hour-22

1. Determination the solubility of drug at room temperature
2. Determination of pKa value by Half Neutralization/ Henderson Hasselbatch equation.
3. Determination of Partition co- efficient of benzoic acid in benzene and water
4. Determination of Partition co- efficient of Iodine in CCl_4 and water
5. Determination of % composition of NaCl in a solution using phenol-water system by CST method
6. Determination of surface tension of given liquids by drop count and drop weight method
7. Determination of critical micellar concentration of surfactants
8. Determination of stability constant and donor acceptor ratio of PABA-Caffeine complex by solubility method
9. Determination of stability constant and donor acceptor ratio of Cupric-Glycine complex by pH titration method

10. Determination of distribution coefficient of I_2 in benzene and water
11. Synthesis of colloidal arsenous sulphide, colloidal iodine etc.

Reference

Text Books:

1. Physical Pharmacy by Alfred Martin
2. Experimental Pharmaceutics by Eugene, Parott.
3. Tutorial Pharmacy by Cooper and Gunn.
4. Stocklosam J. Pharmaceutical Calculations, Lea &Febiger, Philadelphia

Reference Books:

3. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Volume-1 to 3, MarcelDekkar Inc.

4. Liberman H.A, Lachman C, Pharmaceutical Dosage forms. Disperse systems, volume 1, 2, 3. Marcel Dekkar Inc.

5. Physical Pharmaceutics by Ramasamy C and ManavalanR. LaboratoryManual of Physical Pharmaceutics, C.V.S. Subramanyam, J.Thimma settee

6. Test book of Physical Phramacy, by Gaurav Jain & Roop K. Khar

DEPC0403-Essentials of Pharmaceutical Chemistry

Subject Name	Code	Type of course	T-P-P	Prerequisite
Essentials of Pharmaceutical Chemistry	DEPC0403	• Theory +Practice	2-2-0	Nil

Objective

- To know the classification of drug and their sterochemistry
- To understand the drug action on different part of body

Learning outcome

After learning this course student will learn about various type of drug and its application towards the diseases.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test	*20*	Written examination
	Assignment	*10*	Report and Presentation
	Experiments	*20*	Lab work, report
	Project		Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		*50*	Written examination
Total		*100*	

Course outline

Module -I

Basic Principles of Medical Chemistry: Physico-chemical aspects (Optical, geometric and bioisosterism) of drug molecules and biological action. Basic concepts of: Drug metabolism, Prod rugs, Receptors and drug receptor interaction

Module -II **(10 Hrs)**

Classification and uses of the following classes of drugs, with some suitable examples.

Drugs acting on Central nervous System, Autacoids and related drugs , Hormones and related drugs, Drugs affecting cardiovascular system , Drugs acting on Blood and Blood Formation, Drugs acting on Kidney ,Gastrointestinal Drugs

Modules –III **(7 Hrs)**

Classification and uses of the following classes of drugs, with some suitable examples.

Chemotherapeutic agents, Antimicrobials

Practice Hour-20

Preparation of drugs and intermediates

1. Asprin
2. Paracetamol
3. Glycerene from vegetable oil
4. Calcium acetate from raw eggshell

Reference

Text Books:

8. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.
9. Foye's Principles of Medicinal Chemistry.
10. Burger's Medicinal Chemistry, Vol I to IV.
11. Introduction to principles of drug design- Smith and Williams.
12. Remington's Pharmaceutical Sciences.

13. Martindale's extra pharmacopoeia.

Reference Books:

7. Wilson and Grisvold's Text Book of Organic Medicinal and Pharmaceutical Chemistry,Lippincott Williams & Wilkins, 12th Edition, 2011.
8. Foye's Principles of Medicinal Chemistry, Lippincott Williams & Wilkins, 7th Edition, 2012.
9. A Text Book of Medicinal Chemistry: Synthetic and Biochemical Approach, by S.N.Pandeya,Vol.2, S. G. publisher, 1stedin, 2009. by S.N.Pandeya.
10. Medicinal Chemistry by Ashutosh Kar,New Age International Publishers, 5th revised and expanded edn, 2010.
11. Bentley's and Driver's Text Book of Pharmaceutical Chemistry, Oxford Medical Publications, 8th illustrated edn, 1969.
12. Introduction to Medicinal Chemistry by Graham L. Patrick,Oxford, 6thedn, 2017.
13. Essentials of medical Pharmacology, KD TRIPATHI, Seventh Edition, 2013, Jaypee Brothers Medical Publishers (P) Ltd.

DEPC0404-Analytical Techniques for Pharmaceutical Drugs

Subject Name	**Code**	**Type of course**	**T-P-P**	**Prerequisite**
Analytical Techniques for Pharmaceutical Drugs	DEPC0404	• Theory & Lab	2-2-0	Nil

Objective

- Know about the instrumental technique to identify chemical behavior of unknown drugs
- To understand the concept of spectrometry and analyze the presence of different chemical components in the drugs

Learning outcome

After learning this course a student will able to know concept of instrumentation and identify the physical and chemical behavior of Drugs.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***

	Midterm Test	*20*	Written examination
	Assignment	*10*	Report and Presentation
	Experiments	*20*	Lab work, report
	Project		Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		*50(20-IT+30-ET)*	Written examination
Total		*100*	

Course outline

Module-I **(8 Hrs)**

UV-Visible spectroscopy: Beer and Lambert's law, Derivation and deviations. Instrumentation. Applications. Spectrophotometric titrations, Single component and multi component analysis.

Module-II **(10 Hrs)**

IR spectroscopy: Introduction, fundamental modes of vibrations in poly atomic molecules, sample handling, factors affecting vibrations and Instrumentation.

Fluorimetry: Theory, Concepts of singlet, doublet and triplet electronic states, internal and external conversions, factors affecting fluorescence, quenching, instrumentation and applications

Module-III **(10 Hrs)**

Flame Photometry-Principle, interferences, instrumentation and applications

Atomic absorption spectroscopy- Principle, interferences, instrumentation and applications

Nepheloturbidometry- Principle, instrumentation and applications

Practice **Hour-25**

1. Estimation of dextrose by colorimetry
2. Estimation of sulfanilamide by colorimetry
3. Simultaneous estimation of ibuprofen and paracetamol by UV spectroscopy
4. Assay of paracetamol by UV- Spectrophotometry
5. Separation of amino acids by paper chromatography
6. Separation of sugars by thin layer chromatography
7. Separation of plant pigments by column chromatography
8. Molecular Modeling and Geometry optimization of organic compounds.
9. Structure Search and identification by Chemspider.
10. In-Silico Molecular property determination of organic compounds.

Reference

Text Books:

1. Instrumental Methods of Chemical Analysis by B.K Sharma
2. Organic spectroscopy by Y.R Sharma
3. Text book of Pharmaceutical Analysis by Kenneth A. Connors
4. Vogel's Text book of Quantitative Chemical Analysis by A.I. Vogel
5. Practical Pharmaceutical Chemistry by A.H. Beckett and J.B. Stenlake
6. Organic Chemistry by I. L. Finar

Reference Books:

1. Organic spectroscopy by William Kemp
2. Quantitative Analysis of Drugs by D. C. Garrett
3. Quantitative Analysis of Drugs in Pharmaceutical Formulations by P. D. Sethi
4. Spectrophotometric identification of Organic Compounds by Silverstein

Project
DEET0300

Subject Name	Code	Type of course	T-P-P	Prerequisite
Project	DEET0300	• Lab	0-0-6	Nil

DSE COURSES (For Non Domain)

Discipline Specific Elective – 1

BSCH3503 Industrial Chemicals and Environment

BSCH3503-Industrial Chemicals and Environment

Subject Name	Code	Type of course	T-P-P	Prerequisite
Industrial Chemicals and Environment	BSCH3503	• Theory+ Lab	4-2-0	Nil

Objective

- The course structure gives idea about principles and through knowledge of scientific techniques of industrial chemistry
- Prepare students for professional participation in chemical industries so as to adapt themselves to jobs.
- Knowledge regarding environmental pollution and green chemistry

Learning outcome

- After completion of the course, students will able to get knowledge regarding various industrial chemicals which helps them to get job in various industries
- Understanding of air/water pollution regulations and their scientific basis
- Apply knowledge for the protection and improvement of the environment
- Ability to monitor and design the air and water pollution control systems

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test	nil	Written examination
	Assignment	30	Report and Presentation
	Experiments	20	nil
	Project	nil	nil
	Quiz	nil	nil
External Examination		50 (30+20)	Written examination
Total		100	

Course Outline

Module-I (10 Hrs.)
Industrial Gases and Inorganic Chemicals
Industrial Gases: Large scale production, uses, storage and hazards in handling of the following gases: oxygen, nitrogen, argon, neon, helium, hydrogen, acetylene, carbon monoxide, chlorine, fluorine, sulphur dioxide and phosgene.

Module-II (5 Hrs.)

Inorganic Chemicals: Manufacture, application, analysis and hazards in handling the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, borax, bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum, chrome alum, potassium dichromate and potassium permanganate.

Module-III (5 Hrs.)

Environment and its segments
Ecosystems. Biogeochemical cycles of carbon, nitrogen and sulphur. Air Pollution: Major regions of atmosphere. Chemical and photochemical reactions in atmosphere. Air pollutants: types, sources, particle size and chemical nature; Photochemical smog: its constituents and photochemistry. Environmental effects of ozone, Major sources of air pollution. Pollution by SO2, CO2, CO, NOx, H2S and other foul smelling gases. Methods of estimation of CO, NOx, SOx and control procedures. Effects of air pollution on living organisms and vegetation. Greenhouse effect and Global warming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and Halogens, removal of sulphur from coal. Control of particulates.

Module-IV (6 Hrs.)

Water Pollution: Hydrological cycle, water resources, aquatic ecosystems, Sources and nature of water pollutants, Techniques for measuring water pollution, Impacts of water pollution on hydrological and

ecosystems. Water purification methods. Effluent treatment plants (primary, secondary and tertiary treatment).

Module-V(5 Hrs.)
Industrial effluents from the following industries and their treatment: electroplating, textile, tannery, dairy, petroleum and petrochemicals, agro, fertilizer, etc. Sludge disposal. Industrial waste management, incineration of waste. Water treatment and purification (reverse osmosis, electro dialysis, ion exchange). Water quality parameters for waste water, industrial water and domestic water.

Module-VI (8 Hrs.)

Energy & Environment
Sources of energy: Coal, petrol and natural gas. Nuclear Fusion / Fission, Solar energy, Hydrogen, geothermal, Tidal and Hydel, etc. Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its management.

Module-VII (8 Hrs.)

Biocatalysis
Introduction to biocatalysis: Importance in "Green Chemistry" and Chemical Industry.
Industrial Metallurgy Preparation of metals (ferrous and nonferrous) and ultrapure metals for semiconductor technology.

Recommended Books:
1. E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.
2. R.M. Felder, R.W. Rousseau: Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi.
3. J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
4. S. S. Dara: A Textbook of Engineering Chemistry, S. Chand & Company Ltd. New Delhi.
5. K. De, Environmental Chemistry: New Age International Pvt., Ltd, New Delhi.
6. S. M. Khopkar, Environmental Pollution Analysis: Wiley Eastern Ltd, New Delhi.
7. S.E. Manahan, Environmental Chemistry, CRC Press (2005).
8. G.T. Miller, Environmental Science 11th edition. Brooks/ Cole (2006).
9. A. Mishra, Environmental Studies. Selective and Scientific Books, New Delhi (2005).

Practice: Industrial Chemicals & Environment

1. Determination of dissolved oxygen in water.
2. Determination of Chemical Oxygen Demand (COD)
3. Determination of Biological Oxygen Demand (BOD)
4. Percentage of available chlorine in bleaching powder.
5. Measurement of chloride, sulphate and salinity of water samples by simple titration method (AgNO3 and potassium chromate).
6. Estimation of total alkalinity of water samples (CO_3^{2-}, HCO_3 ") using double titration method.
7. Measurement of dissolved CO_2.
8. Study of some of the common bio-indicators of pollution.
9. Estimation of SPM in air samples.
10. Preparation of borax/ boric acid.

Recommended Books:
1. E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.
2. R.M. Felder, R.W. Rousseau: Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi.
3. J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
4. S. S. Dara: A Textbook of Engineering Chemistry, S. Chand & Company Ltd. New Delhi.

5. K. De, Environmental Chemistry: New Age International Pvt., Ltd, New Delhi.
6. S. M. Khopkar, Environmental Pollution Analysis: Wiley Eastern Ltd, New Delhi.

BSCH3504 Inorganic Materials of Industrial Importance

Subject Name	Code	Type of course	T-P-P	Prerequisite
Inorganic Materials of Industrial Importance	BSCH3504	Theory & Lab	4-2-0	Industrial Chemistry

Objective

- The course covers different types of glass materials, cements, ceramics, fertilizers, batteries, surface coatings, alloys and catalysts as well as their manufacturing process and applications in day to day life.
- The course structure gives insight knowledge about different inorganic materials that have gain importance in human civilization.

Learning outcome

- *After studying the course students should know different types of inorganic materials those are used in modern civilization for various purposes.*
- *They will know how these materials are manufactured and where they are used.*
- *Students will learn various types of batteries manufacturing methods and their applications*
- *After completion of the course students should have a thorough knowledge on catatysis reactions , cement composition, types as well as manufacturing methods.*
- *They will know various alloys , manufacturing process of stainless steel and their classification*
- *They should know the objectives of surface coating and different paints, pigments, Fillers, Thinners, Enamels, emulsifying agents, dyes and their applications.*

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test		Written examination
	Assignment	*30*	Report and Presentation
	Experiments	*20*	Lab work, report
	Project		Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		*50*	Written examination
Total		*100*	

Course Outline

Module-1 **(6Hrs)**

Silicate Industries:

Glass: Glassy state and its properties, classification (silicate and non-silicate glasses). Manufacture and processing of glass. Composition and properties of the following types of glasses: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass, fluorosilicate, coloured glass, photosensitive glass.

Module-II **(5Hrs)**

Ceramics: Important clays and feldspar, ceramic, their types and manufacture. High technology ceramics and their applications, superconducting and semiconducting oxides, fullerenes carbon nanotubes and carbon fibre. Cements: Classification of cement, ingredients and their role, Manufacture of cement and the setting process, quick setting cements.

Module-III **(5Hrs)**

Fertilizers:Different types of fertilizers. Manufacture of the following fertilizers: Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates; polyphosphate, superphosphate, compound and mixed fertilizers, potassium chloride, potassium sulphate

Module-IV **(9hrs)**

Surface Coatings:

Objectives of coatings surfaces, preliminary treatment of surface, classification of surface coatings. Paints and pigments-formulation, composition and related properties. Oil paint, Vehicle, modified oils, Pigments, toners and lakes pigments, Fillers, Thinners, Enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint), Dyes, Wax polishing, Water and Oil paints, additives, Metallic coatings (electrolytic and electroless), metal spraying and anodizing

Module-V **(6Hrs)**

Batteries:

Primary and secondary batteries, battery components and their role, Characteristics of Battery. Working of following batteries: Pb acid, Li-Battery, Solid state electrolyte battery.Fuel cells, Solar cell and polymer cell.

Module-VI **(7Hrs)**

Alloys:

Classification of alloys, ferrous and non-ferrous alloys, Specific properties of elements in alloys. Manufacture of Steel (removal of silicon decarbonization, demanganization, desulphurization dephosphorisation) and surface treatment (argon treatment, heat treatment, nitriding, carburizing). Composition and properties of different types of steels.

Module-VII **(7Hrs)**

Catalysis:

General principles and properties of catalysts, homogenous catalysis (catalytic steps and examples) and heterogenous catalysis (catalytic steps and examples) and their industrial applications, Deactivation or regeneration of catalysts. Phase transfer catalysts, application of zeolites as catalysts.

Recommended Books:

1. E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.
2. R. M. Felder, R. W. Rousseau: Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi.
3. W. D. Kingery, H. K. Bowen, D. R. Uhlmann: Introduction to Ceramics, Wiley Publishers, New Delhi.
4. J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
5. P. C. Jain, M. Jain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi.
6. R. Gopalan, D. Venkappayya, S. Nagarajan: Engineering Chemistry, Vikas Publications, New Delhi.
7. Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut (1996).

Practicals Inorganic Materials of Industrial Importance

1. Determination of free acidity in ammonium sulphate fertilizer.
2. Estimation of Calcium in Calcium ammonium nitrate fertilizer.

3. Estimation of phosphoric acid in superphosphate fertilizer.
4. Determination of composition of dolomite (by complexometric titration).
5. Analysis of (Cu, Ni); (Cu, Zn) in alloy or synthetic samples.
6. Analysis of Cement.
7. Preparation of pigment (zinc oxide).

Recommended Books:
Text Book
1. E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.
2. R. M. Felder, R. W. Rousseau: Elementary Principles of Chemical Processes, Wiley
3. Publishers, New Delhi.
4. W. D. Kingery, H. K. Bowen, D. R. Uhlmann: Introduction to
Ceramics, Wiley Publishers, New Delhi.

BSCH3603 Research Methodology for Chemistry

Subject Name	Code	Type of course	T-P-P	Prerequisite
Research Methodology for Chemistry	BSCH3603	• Theory	4-0-0	Nil

Objective

Key points:

- To impart knowledge to students regarding the basics of scientific communication through writing skills.
- To gain knowledge on dealing of different type of hazardous chemicals.
- To access knowledge regarding different type of data analysis

Learning outcome

- *Gain sound knowledge regarding writing skills for scientific communication, scientific ethics, avoiding plagiarism etc.*
- *Know how to safely store, procedure to work with, recycling and recovery of hazardous chemical and their safe transportation.*
- *They will also know how to deal, analyze and interpret with different data through mathematical and statistical methods.*

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test	*20*	Written examination
	Assignment	*10*	Report and Presentation
	Experiments	*20*	Lab work, report
	Project	-	Report and presentation
	Quiz	-	Surprise/preannounced ones
External Examination		*20+30*	Written examination
Total		*100*	

Course Outline

Module-I **(7 Hrs.)**

Literature Survey:

Methods of Scientific Research and Writing Scientific Papers-I:

Reporting practical and project work. Writing literature surveys and reviews. Organizing a poster display. Giving an oral presentation.

Module-II **(8 Hrs.)**

Methods of Scientific Research and Writing Scientific Papers-II:

Writing scientific papers - justification for scientific contributions, bibliography, description of methods, conclusions, the need for illustration, style, publications of scientific work. Writing ethics. Avoiding plagiarism.

Module-III **(4 Hrs.)**

Chemical Safety and Ethical Handling of Chemicals:

Safe working procedure and protective environment, protective apparel, emergency procedure and first aid, laboratory ventilation.

Module-IV **(5 Hrs.)**

Safe storage and use of hazardous chemicals, procedure for working with substances that pose hazards, flammable or explosive hazards, procedures for working with gases at pressures above or below atmospheric - safe storage and disposal of waste chemicals.

Module-V **(6 Hrs.)**

Recovery recycling and reuse of laboratory chemicals, procedure for laboratory disposal of explosives, identification, verification and segregation of laboratory waste, disposal of chemicals in the sanitary sewer system, incineration and transportation of hazardous chemicals.

Module-VI **(7 Hrs.)**

Data Analysis-I

The Investigative Approach: Making and Recording Measurements. SI Units and their use. Scientific method and design of experiments. Analysis and Presentation of Data: Descriptive statistics. Choosing and using statistical tests. Chemometrics.

Module-VII **(8 Hrs.)**

Data Analysis-II

Correlation and regression, Curve fitting, fitting of linear equations, simple linear cases, weighted linear case, analysis of residuals, General polynomial fitting, linearizing transformations, exponential function fit, and its abuse. Basic aspects of multiple linear regression analysis.

Recommended Books:

1. Dean, J. R., Jones, A. M., Holmes, D., Reed, R., Weyers, J. & Jones, A. (2011)
2. Practical skills in chemistry. 2nd Ed. Prentice-Hall, Harlow.
3. Hibbert, D. B. & Gooding, J. J. (2006) Data analysis for chemistry. Oxford University Press.
4. Topping, J. (1984) Errors of observation and their treatment. Fourth Ed., Chapman Hall, London.
5. Harris, D. C. Quantitative chemical analysis. 6th Ed., Freeman (2007) Chapters 3-5.
6. Levie, R. de, How to use Excel in analytical chemistry and in general scientific data analysis. Cambridge Univ. Press (2001) 487 pages.
7. Chemical safety matters - IUPAC - IPCS, Cambridge University Press, 1992. OSU safety manual 1.01

BSCH3604 Instrumental Methods of Chemical Analysis

Subject Name	Code	Type of course	T-P-P	Prerequisite
Instrumental Methods of Chemical Analysis	BSCH3604	•Theory & Lab	4-2-0	Nil

Objective

- To impart basic and knowledge of different spectroscopic techniques.
- To know details of basic analytical techniques for quantitative analysis of elements as well different chromatographic techniques for separation and isolation of chemical entities.

Learning outcome

- *Understand the working principles and analyzing methods of different spectroscopic techniques like FTIR, UV-Visible, NMR as well as atomic absorption spectroscopy.*
- *They will also gain knowledge to interprete the data from above mentioned analytical techniques.*
- *Know and understand properly how to separate and isolate chemical compounds in a mixture by chromatographic methods*

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test	*20*	Written examination
	Assignment	*10*	Report and Presentation
	Experiments	*20*	Lab work, report
	Project		Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		*20+30*	Written examination
Total		*100*	

Course Outline

Module-I (6 Hrs.)
Introduction to spectroscopic methods of analysis:
Recap of the spectroscopic methods covered in detail in the core chemistry syllabus:
Treatment of analytical data, including error analysis. Classification of analytical methods and the types of instrumental methods. Consideration of electromagnetic radiation.

Module-II (5 Hrs.)
Molecular spectroscopy:
Infrared spectroscopy:Interactions with molecules: absorption and scattering. Means of excitation (light sources), separation of spectrum (wavelength dispersion, time resolution), detection of the signal (heat, differential detection), interpretation of spectrum (qualitative, mixtures, resolution), advantages of Fourier Transform (FTIR). Samples and results expected.

Module-III (5 Hrs.)
Molecular spectroscopy instrumentation and application:
Applications: Issues of quality assurance and quality control, Special problems for portable instrumentation and rapid detection.UV-Visible/ Near IR - emission, absorption, fluorescence and photoaccoustic. Excitation sources (lasers, time resolution), wavelength dispersion (gratings, prisms, interference filters, laser, placement of sample relative to dispersion, resolution).

Module-IV(8 Hrs.)
Separation techniques
Chromatography: Gas Chromatography, liquid Chromatography, supercritical fluids, Importance of column technology (packing, capillaries), Separation based on increasing number of factors (volatility, solubility, interactions with stationary phase, size, electrical field).

Module-V(6 Hrs.)

Separation techniques:

Detection: simple vs. specific (gas and liquid), Detection as a means of further analysis (use of tags and coupling to IR and MS), Mass spectroscopy: Making the gaseous molecule into an ion (electron impact, chemical ionization

Module-VI (8 Hrs.)

Elemental analysis of spectrophotometers :

Atomic spectroscopy: Atomic absorption, Atomic emission, and Atomic fluorescence. Excitation and getting sample into gas phase (flames, electrical discharges, plasmas), Wavelength separation and resolution (dependence on technique), Detection of radiation (simultaneous/scanning, signal noise), Interpretation (errors due to molecular and ionic species, matrix effects, other interferences).

Module-VII (7Hrs.)

Spectrophotometers princeple and application:
NMR spectroscopy: Principle, Instrumentation, Factors affecting chemical shift, Spincoupling, Applications.Electroanalytical Methods: Potentiometry & Voltammetry X-ray analysis and electron spectroscopy (surface analysis)

Recommended Books:
1. D.A. Skoog, F.J. Holler & S. Crouch (ISBN 0-495-01201-7) Principles of Instrumental Analysis, Cengage Learning India Edition, 2007.
2. Willard, Merritt, Dean, Settle, Instrumental Methods of Analysis, 7th ed, IBH Book House, New Delhi.
3. Atkins, P.W & Paula, J.D. Physical Chemistry, 10th Ed., Oxford University Press (2014).
4. Kakkar, R. Atomic and Molecular Spectroscopy: Concepts and Applications. Cambridge University Press, 2015.
5. Castellan, G. W. Physical Chemistry 4th Ed., Narosa (2004).
6. Banwell, C. N. & McCash, E. M. Fundamentals of Molecular Spectroscopy 4th Ed. Tata McGraw-Hill: New Delhi (2006).62
7. Smith, B.C. Infrared Spectral Interpretations: A Systematic Approach. CRC Press, 1998.
8. Moore, W.J., Physical Chemistry Orient Blackswan, 1999.

LAB: Instrumental Methods of Chemical Analysis

1. Safety Practices in the Chemistry Laboratory
2. Determination of the isoelectric pH of a protein.
3. Titration curve of an amino acid.
4. Determination of the void volume of a gel filtration column.
5. Determination of a Mixture of Cobalt and Nickel (UV/Vis spec.)
6. Study of Electronic Transitions in Organic Molecules (i.e., acetone in water)
7. IR Absorption Spectra (Study of Aldehydes and Ketones)

8. Determination of Calcium, Iron, and Copper in Food by Atomic Absorption
9. Quantitative Analysis of Mixtures by Gas Chromatography (i.e., chloroform and carbon tetrachloride)
13. Cyclic Voltammetry of the Ferrocyanide/ Ferricyanide Couple

Recommended Books:
1. Skoog, D.A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed.
2. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. Instrumental Methods of Analysis, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA,

Skill Enhancement Courses (Any two of the following)

Pharmaceutical Chemistry

Subject Name	Code	Type of course	T-P-P	Prerequisite
Pharmaceutical Chemistry	**BSCS2301**	• Lab	0-2-0	Basic knowledge of organic chemistry

Objective

- All the B.SC students having one organic chemistry paper in 1st year B.Sc can study

Learning outcome

- To ensure that the students, upon graduation, will appreciate and demonstrate the importance and significance of research in pharmaceutical care and developing sustainable life-long learning habits.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test		Written examination
	Assignment		Report and Presentation
	Experiments	*100*	Lab work, report
	Project		Report and presentation
	Quiz		Surprise/preannounced ones
External Examination			Written examination

Course outline

Drugs & Pharmaceuticals
Drug discovery, design and development; Basic Retrosynthetic approach. Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol, lbuprofen); antibiotics Chloramphenicol); antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim); antiviral agents (Acyclovir)

Practice

1. Extraction of Plant materials
2. Photochemical screening of herbal extracts

3. Isolation of Starch from Potato
4. Assay of Drug by Titrimetric Method
5. Determination of Partition Coefficient of supplied organic compound
6. Molecular Modeling and Geometry optimization of organic compounds.
7. Structure Search and identification by Chemspider.
8. In-Silico Molecular property determination of organic compounds.

Reference Books:

1. *Patrick, G. L. Introduction to Medicinal Chemistry, Oxford University Press, UK, 2013.*
2. Singh, H. & Kapoor, V.K. *Medicinal and Pharmaceutical Chemistry,* Vallabh Prakashan, Pitampura, New Delhi, 2012.
3. Foye, W.O., Lemke, T.L. & William, D.A.: *Principles of Medicinal Chemistry,* 4th ed., B.I. Waverly Pvt. Ltd. New Delhi.

BSCS2302-Analytical Clinical Biochemistry

Subject Name	Code	Type of course	T-P-P	Prerequisite
Analytical Clinical Biochemistry	**BSCS2302**	• Lab	4-2-0	Nil

Objective

- Students should have brief knowledge on chemical and biochemical processes.
- All the 1st sem B.SC student can opt this skill course

Learning outcome

- *To Know the basic chemical theory,*
- *To describe the intermediates of metabolism, their reactions, the control mechanisms of metabolism and the common disorders of metabolism,*
- *Carry out simple chemical and biochemical syntheses,*
- *Describe the function of human body, common patho physiological mechanisms, common diseases and the chemical and biochemical methods used in their study,*

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test		Written examination
	Assignment		Report and Presentation
	Experiments	*100*	Lab work, report
	Project		Report and presentation
	Quiz		Surprise/preannounced ones
External Examination			Written examination
Total		*100*	

Course outline

Basic understanding

Carbohydrates: Biological importance of carbohydrates, Metabolism, Cellular currency of energy (ATP), Glycolysis, Alcoholic and Lactic acid fermentations, Krebs cycle. Isolation and characterization of polysachharides.

Biochemistry of disease: A diagnostic approach by blood/ urine analysis.

Blood: Composition and functions of blood, blood coagulation. Blood collection and preservation of samples. Anaemia, Regulation, estimation and interpretation of data for blood sugar, urea, creatinine, cholesterol and bilirubin.
Urine: Collection and preservation of samples. 6. Formation of urine. Composition and estimation of constituents of normal and pathological urine.

Practice

1. General consideration on specimen collection in the Lab (Blood, Stool, Urine, sputum pus, semen)
2. Routine examination of urine sample albumin, sugar, bile salt, bile pigment, ketone body
3. Detection of HCG (Hormonal Test)
4. Detection of Blood Glucose and cholesterol
5. Estimation of hemoglobin, DLC, Blood group and total lymphocyte count.

Recommended Books:

1. Cooper, T.G. *Tool of Biochemistry*. Wiley-Blackwell (1977).
2. Wilson, K. & Walker, J. *Practical Biochemistry.* Cambridge University Press (2009).
3. Varley, H., Gowenlock, A.H & Bell, M.: *Practical Clinical Biochemistry,* Heinemann, London (1980).
4. *Devlin, T.M., Textbook of Biochemistry with Clinical Correlations, John Wiley & Sons, 2010.*

BSCH2003-Green method in chemistry

SubjectName	Code	Type of course	T-P-P	Prerequisite
Green Method in Chemistry	BSCH2003	•Lab	0+0+3	Nil

Objective

Reduce **chemical** related impact on human health and virtually eliminate contamination of the environment through dedicated, sustainable prevention programs.

Learning outcome.

- **Green chemistry** aims to design and produce cost-competitive **chemical** products and processes that attain the highest level of the pollution-prevention hierarchy by reducing pollution at its source

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test		Written examination
	Assignment		Report and Presentation
	Experiments	*50*	Lab work, report
	Project	*50*	Report and presentation
	Quiz		Surprise/preannounced ones
External Examination			Written examination
Total		*100*	

GREEN CHEMISTRY LAB

1. Concepts on Green Chemistry, Goals, needs of Green Chemistry
2. Preparation of biodiesel from vegetable/ waste cooking oil.
3. Preparation of propene from 1-propanol + conc. sulphuric acid
4. Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide.
5. Extraction of D-limonene from orange peel using liquid CO2 prepared form dry ice.
6. Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper (II).
7. Preparation and characterization of nanoparticles of gold using tea leaves

BSCH2004-Basic Analytical Chemistry

SubjectName	Code	Type of course	T-P-P	Prerequisite
Basic Analytical Chemsitry	BSCH2004	• Lab	0+3+0	Nil

Objective

- To provide a basic knowledge and understanding of essential chemical and physical principles for analytical chemistry. To introduce basic analytical techniques and practical aspects of classical chemical analysis. To solve problems related to chemical analysis and interpret analytical results.

Learning outcome

- Are able to design, carry out, record and analyze the results of chemical experiments.
- Are able to use modern instrumentation and classical techniques, to design experiments, and to properly record the results of their experiment.
- Are skilled in problems solving, critical thinking and analytical reasoning.
- Are able to identify and solve chemical problems and explore new areas of research.
- Are able to use modern library searching and retrieval methods to obtain information about a topic, chemical, chemical technique, or an issue relating to chemistry.
- Knows the proper procedures and regulations for safe handling and use of chemicals and can follow the proper procedures and regulations for safe handling when using chemicals

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test		Written examination
	Assignment		Report and Presentation
	Experiments	*50*	Lab work, report
	Project	*50*	Report and presentation
	Quiz		Surprise/preannounced ones
External Examination			Written examination
Total		*100*	

Course Outline

Introduction:
Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling. Importance of accuracy, precision and sources of error in analytical measurements. Presentation of experimental data and results, from the point of view of significant figures.
Analysis of soil:
Composition of soil, Concept of pH and pH measurement, Complexometric titrations, Chelation, Chelating agents, use of indicators

a. Determination of pH of soil samples.
b. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration.

Analysis of water:
Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods.

a. Determination of pH, acidity and alkalinity of a water sample.
b. Determination of dissolved oxygen (DO) of a water sample.

Analysis of food products:
Nutritional value of foods, idea about food processing and food preservations and adulteration.

a. Identification of adulterants in some common food items like coffee powder, asafetida, chilli powder, turmeric powder, coriander powder and pulses, etc.
b. Analysis of preservatives and colouring matter.

Chromatography:
Definition, general introduction on principles of Chromatography, paper chromatography, TLC etc.

a. Paper Chromatographic separation of mixture of metal ion (Fe^3+ and Al^3+).
b. To compare paint samples by TLC method.

Suggested Applications (Any one):

a. To study the use of phenolphthalein in trap cases.
b. To analyze arson accelerants.
c. To carry out analysis of gasoline.

Recommended Books:

1. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis,* 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
2. Skoog, D.A., Holler, F.J. & Crouch, S. *Principles of Instrumental Analysis,* Cengage Learning India Edition, 2007.
3. Skoog, D.A.; West, D.M. & Holler, F.J. *Analytical Chemistry: An Introduction 6th Ed.,* Saunders College Publishing, Fort Worth, Philadelphia (1994).
4. Harris, D. C. *Quantitative Chemical Analysis,* 9th ed. Macmillan Education, 2016.
5. Dean, J. A. *Analytical Chemistry Handbook,* McGraw Hill, 2004.
6. Day, R. A. & Underwood, A. L. *Quantitative Analysis,* Prentice Hall of India, 1992.
7. Freifelder, D.M. *Physical Biochemistry 2nd Ed.,* W.H. Freeman & Co., N.Y. USA (1982).
8. Cooper, T.G. *The Tools of Biochemistry*, John Wiley & Sons, N.Y. USA. 16 (1977).
9. *Vogel, A. I. Vogel's Qualitative Inorganic Analysis 7th Ed., Prentice Hall, 1996.*
10. *Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.*
11. Robinson, J.W. *Undergraduate Instrumental Analysis 5th Ed.,* Marcel Dekker, Inc., New York (1995).
12. Christian, G.D. *Analytical Chemistry,* 6th Ed. John Wiley & Sons, New York, 2004.

Basket-5

Generic Elective (GE)

(Subjects from other Disciplines)

Discipline Specific Elective Paper for CBCS Chemistry Syllabus