ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY

Guwahati

Course Structure and Syllabus

B.Sc. CHEMISTRY (HONOURS)
Under CBCS

(From Academic Session 2018-19 onwards)

3rd Semester

ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY
Course Structure and Syllabus
(From Academic Session 2018-19 onwards)

3rd Semester B.Sc. Chemistry (HONOURS)
Course Structure:

Theory/ Practical	Sl. No.	Sub Code	Subject	Hours Per week			Credit	Marks	
				L	T	P	C		
CORE (For Chemistry honours)								**CE**	**ESE**
Theory	1	BCH181C301	Inorganic Chemistry –II	4	0	0	4	30	70
	2	BCH181C302	Organic Chemistry-II	4	0	0	4	30	70
	3	BCH181C303	Physical Chemistry-III	4	0	0	4	30	70
Practical	1	BCH181C311	Inorganic Chemistry Lab-II	0	0	4	2	15	35
	2	BCH181C312	Organic Chemistry Lab-II	0	0	4	2	15	35
	3	BCH181C313	Physical Chemistry Lab-III	0	0	4	2	15	35
SEC-1 (Any One Paper) Skill Enhancement Course									
Theory	1	BCH181SE304	Basic Analytical Chemistry	2	0	0	2	30	70
	2	BCH181SE305	Analytical Clinical Biochemistry	2	0	0	2	30	70
	3	BCH181SE306	Pharmaceutical Chemistry	2	0	0	2	30	70
Generic Elective-3 (Chemistry: For Other Disciplines)									
Theory	1	BGENC181307	Solutions, Phase Equilibria, Conductance, Electro-chemistry & Functional Group Organic Chemistry-II	4	0	0	4	30	70
Practical	1	BGENC181317	Solutions, Phase Equilibria, Conductance, Electro-chemistry & Functional Group Organic Chemistry-II Lab	0	0	4	2	15	35
Total				18	0	16	**26**	**210**	**490**
Total contact hours per week: 34 **Total Credit : 26**									

Course Code	Course Title	Hours per week L-T-P	Credit C
BCH181C301	**Inorganic Chemistry –II**	**4-0-0**	**4**

MODULE 1: General Principles of Metallurgy (6 Lectures)

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, van Arkel-de Boer process and Mond's process, Zone refining.

MODULE 2: Acids and Bases (8 Lectures)

Brönsted-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 3: Chemistry of s and p Block Elements: (30 Lectures)

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.

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, Oxides and oxoacids of nitrogen, Phosphorus and chlorine. Peroxo acids of sulphur, interhalogen compounds, polyhalide ions, pseudohalogens and basic properties of halogens.

MODULE 4: Noble Gases: (8 Lectures)

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 5: Inorganic Polymers: (8 Lectures)

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

Reference 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.
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).

Course Code	Course Title	Hours per week L-T-P	Credit C
BCH181C302	**Organic Chemistry-II**	**4-0-0**	**4**

MODULE 1: Chemistry of Halogenated Hydrocarbons: (16 Lectures)

Alkyl halides: Methods of preparation, nucleophilic substitution reactions – SN_1, SN_2 and SNi mechanisms with stereo chemical aspects and effect of solvent etc.; nucleophilic substitution vs. elimination.

Aryl halides: Preparation, including preparation from Diaz onium 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 2: Alcohols, Phenols, Ethers and Epoxides: (16 Lectures)

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;

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 $LiAlH_4$

MODULE 3: Carbonyl Compounds: Structure, reactivity and preparation; (14 Lectures)

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, haloform reaction and Baeyer Villiger oxidation, αsubstitution reactions, oxidations and reductions (Clemmensen, Wolff-Kishner, $LiAlH_4$, $NaBH_4$, 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 4: Carboxylic Acids and their Derivatives: (10 Lectures)

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; Comparative study of nucleophilic substitution at acyl group -Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann bromamide degradation and Curtius rearrangement.

MODULE 5: Sulphur containing compounds: (4 Lectures)

Preparation and reactions of thiols, thioethers and sulphonic acids.

Reference 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.

Course Code	Course Title	Hours per week L-T-P	Credit C
BCH181C303	**Physical Chemistry-III**	**4-0-0**	**4**

MODULE 1: Phase Equilibria (28 Lectures)

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

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

MODULE 2: Chemical Kinetics (18 Lectures)

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. 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 3: Catalysis (18 Lectures)

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 4: Surface chemistry (6 Lectures)

Physical adsorption, chemisorption, adsorption isotherms. nature of adsorbed state.

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

Course Code	Course Title	Hours per week L-T-P	Credit C
BCH181C311	**Inorganic Chemistry Lab-II**	**0-0-4**	**2**

A. Iodo / Iodimetric Titrations

i. Estimation of Cu(II) and $K_2Cr_2O_7$ using sodium thiosulphate solution (Iodimetrically).
ii. Estimation of (i) arsenite and (ii) antimony in tartar-emetic iodimetrically
iii. Estimation of available chlorine in bleaching powder iodometrically.

B. Inorganic preparations

i. Cuprous Chloride, Cu_2Cl_2
ii. Preparation of Manganese(III) phosphate, $MnPO_4.H_2O$
iii. Preparation of Aluminium potassium sulphate $KAl(SO_4)_2.12H_2O$ (Potash alum) or Chrome alum.

Reference Books:

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

Course Code	Course Title	Hours per week L-T-P	Credit C
BCH181C312	**Organic Chemistry Lab-II**	**0-0-4**	**2**

1. **Functional group tests for alcohols, phenols, carbonyl and carboxylic acid group.**
2. **Organic preparations:**
   i. Acetylation of one of the following compounds: amines (aniline, o-, m-, p- toluidines and o-, m-, p-anisidine) and phenols (β-naphthol, vanillin, salicylic acid) by any one method: a. Using conventional method. b. Using green approach
   ii. Benzolyation of one of the following amines (aniline, o-, m-, p- toluidines and o-, m-, p-anisidine) and one of the following phenols (β-naphthol, resorcinol, pcresol) by Schotten-Baumann reaction.
   iii. Oxidation of ethanol/ isopropanol (Iodoform reaction).
   iv. Bromination of any one of the following: a. Acetanilide by conventional methods b. Acetanilide using green approach (Bromate-bromide method)
   v. Nitration of any one of the following: a. Acetanilide/nitrobenzene by conventional method b. Salicylic acid by green approach (using ceric ammonium nitrate).
   vi. Selective reduction of meta dinitrobenzene to m-nitroaniline.
   vii. Reduction of p-nitrobenzaldehyde by sodium borohydride.
   viii. Hydrolysis of amides and esters.
   ix. Semicarbazone of any one of the following compounds: acetone, ethyl methyl ketone, cyclohexanone, benzaldehyde.
   x. S-Benzylisothiouronium salt of one each of water soluble and water insoluble acids (benzoic acid, oxalic acid, phenyl acetic acid and phthalic acid).
   xi. Aldol condensation using either conventional or green method. xii. Benzil-Benzilic acid rearrangement.

The above derivatives should be prepared using 0.5-1g of the organic compound. The solid samples must be collected and may be used for recrystallization, melting point and TLC.

Reference 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).

Course Code	Course Title	Hours per week L-T-P	Credit C
BCH181C313	**Physical Chemistry Lab-III**	**0-0-4**	**2**

1. Determination of critical solution temperature and composition of the phenol-water system and to study the effect of impurities on it.
2. Phase equilibria: Construction of the phase diagram using cooling curves or ignition tube method:
   i. simple eutectic and
   ii. congruently melting systems.
3. Distribution of acetic/ benzoic acid between water and cyclohexane.
4. Study the equilibrium of at least one of the following reactions by the distribution method:
   i. $I_2(aq) + I^- \rightarrow I_3^-(aq)$
   ii. $Cu^{2+}(aq) + {}_nNH3 \rightarrow Cu(NH_3)_n^{2+}$
5. Study the kinetics of the following reactions.
   i. Initial rate method: Iodide-persulphate reaction
   ii. Integrated rate method: (i). Acid hydrolysis of methyl acetate with hydrochloric acid. (ii). Saponification of ethyl acetate.
   iii. Compare the strengths of HCl and H_2SO_4 by studying kinetics of hydrolysis of methyl acetate.

Adsorption

1. Verify the Freundlich and Langmuir isotherms for adsorption of acetic acid on activated charcoal.

Reference 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).

Course Code	Course Title	Hours per week L-T-P	Credit C
BCH181SE304	**Basic Analytical Chemistry**	**2-0-0**	**2**

(Hands on Exercises: 60 Lectures)

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.

MODULE 1: 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.

MODULE 2: 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.

MODULE 3: 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, asafoetida, chilli powder, turmeric powder, coriander powder and pulses, etc.
b. Analysis of preservatives and colouring matter.

MODULE 4: 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.

MODULE 5: Ion-exchange:

Column, ion-exchange chromatography etc.
Determination of ion exchange capacity of anion / cation exchange resin (using batch procedure if use of column is not feasible).

MODULE 6: Analysis of cosmetics:
Major and minor constituents and their function

a. Analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride, sulphate.
b. Determination of constituents of talcum powder: Magnesium oxide, Calcium oxide, Zinc oxide and Calcium carbonate by complexometric titration.

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.

Suggested Instrumental demonstrations:

a. Estimation of macro nutrients: Potassium, Calcium, Magnesium in soil samples by flame photometry.
b. Spectrophotometric determination of Iron in Vitamin / Dietary Tablets.
c. Spectrophotometric Identification and Determination of Caffeine and Benzoic Acid in Soft Drinks.

Reference 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.

Course Code	Course Title	Hours per week L-T-P	Credit C
BCH181SE305	**Analytical Clinical Biochemistry**	**2-0-0**	**2**

(Hands on Exercises: 60 Lectures)

MODULE 1:

Basic understanding of the structures, properties and functions of carbohydrates, lipids and proteins:

Review of concepts studied in the core course:

Carbohydrates:

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

Proteins:

Classification, biological importance; Primary and secondary and tertiary structures of proteins: α-helix and β- pleated sheets, Isolation, characterization, denaturation of proteins.

Enzymes:

Nomenclature, Characteristics (mention of Ribozymes), Classification; Active site, Mechanism of enzyme action, Stereo specificity of enzymes, Coenzymes and cofactors, Enzyme inhibitors, Introduction to Biocatalysis: Importance in "Green Chemistry" and Chemical Industry.

Lipids:

Classification. Biological importance of triglycerides and phosphoglycerides and cholesterol; Lipid membrane, Liposomes and their biological functions and underlying applications.
Lipoproteins.
Properties, functions and biochemical functions of steroid hormones.
Biochemistry of peptide hormones.

MODULE 2:

Structure of DNA (Watson-Crick model) and RNA, Genetic Code, Biological roles of DNA and RNA:

Replication, Transcription and Translation, Introduction to Gene therapy.

Enzymes:

Nomenclature, classification, effect of pH, temperature on enzyme activity, enzyme inhibition.

MODULE 3:

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.

Practicals

Identification and estimation of the following:

1. Carbohydrates – qualitative and quantitative.
2. Lipids – qualitative.
3. Determination of the iodine number of oil.
4. Determination of the saponification number of oil.
5. Determination of cholesterol using Liebermann- Burchard reaction.
6. Proteins – qualitative.
7. Isolation of protein.
8. Determination of protein by the Biuret reaction.
9. Determination of nucleic acids

Reference 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.
5. Berg, J.M., Tymoczko, J.L. & Stryer, L. Biochemistry, W.H. Freeman, 2002.
6. Talwar, G.P. & Srivastava, M. Textbook of Biochemistry and Human Biology, 3rd Ed. PHI Learning.
7. Nelson, D.L. & Cox, M.M. Lehninger Principles of Biochemistry, W.H. Freeman, 2013.
8. O. Mikes, R.A. Chalmers: Laboratory Handbook of Chromatographic Methods, D. Van Nostrand & Co., 1961.

Course Code	Course Title	Hours per week L-T-P	Credit C
BCH181SE306	**Pharmaceutical Chemistry**	**2-0-0**	**2**

(Hands on Exercises: 60 Lectures)

MODULE 1: 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), Central Nervous System agents (Phenobarbital, Diazepam), Cardiovascular (Glyceryl triturate), antilaprosy (Dapsone), HIV-AIDS related drugs (AZT- Zidovudine).

MODULE 2: Fermentation

Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii) Antibiotics; Penicillin, Cephalosporin, Chloromycetin and Streptomycin, (iii) Lysine, Glutamic acid, Vitamin B2, Vitamin B12 and Vitamin C.

Practicals

1. Preparation of Aspirin and its analysis.
2. Preparation of magnesium bisilicate (Antacid).

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.

Course Code	Course Title	Hours per week L-T-P	Credit C
BGENC181307	**Solutions, Phase Equilibria, Conductance, Electro-chemistry & Functional Group Organic Chemistry-II**	**4-0-0**	**4**

Section A: Physical Chemistry

MODULE 1: Solutions (8 Lectures)

Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions. Vapour pressure-composition and temperature composition curves of ideal and non-ideal solutions. Distillation of solutions. Lever rule. Azeotropes.

Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids- Principle of steam distillation. Nernst distribution law and its applications, solvent extraction.

MODULE 2: Phase Equilibria (8 Lectures)

Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic derivation. Derivation of Clausius – Clapeyron equation and its importance in phase equilibria. Phase diagrams of one-component systems (water and sulphur) and two component systems involving eutectics, congruent and incongruent melting points (lead-silver, $FeCl_3$-H_2O and Na-K only).

MODULE 3: Conductance (6 Lectures)

Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch law of independent migration of ions.

Transference number and its experimental determination using Hittorf and Moving boundary methods. Ionic mobility. Applications of conductance measurements: determination of degree of ionization of weak electrolyte, solubility and solubility products of sparingly soluble salts, ionic product of water, hydrolysis constant of a salt. Conductometric titrations (only acid base).

MODULE 4: Electrochemistry (8 Lectures)

Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential. Electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties: ΔG, ΔH and ΔS from EMF data.

Calculation of equilibrium constant from EMF data. Concentration cells with transference and without transference. Liquid junction potential and salt bridge.

pH determination using hydrogen electrode and quinhydrone electrode.

Potentiometric titrations -qualitative treatment (acid-base and oxidation-reduction only).

Section B: Organic Chemistry-3

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

MODULE 5: (6 Lectures)

Carboxylic acids and their derivatives

i. Carboxylic acids (aliphatic and aromatic)

ii. Preparation: Acidic and Alkaline hydrolysis of esters.

iii. Reactions: Hell – Vohlard - Zelinsky Reaction.

Carboxylic acid derivatives (aliphatic): (Upto 5 carbons)

i. Preparation: Acid chlorides, Anhydrides, Esters and Amides from acids and their interconversion.
ii. Reactions: Comparative study of nucleophilicity of acyl derivatives. Reformatsky Reaction, Perkin condensation.

MODULE 6: (6 Lectures)

Amines and Diazonium Salts

i. Amines (Aliphatic and Aromatic): (Upto 5 carbons)
ii. Preparation: from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction.
iii. Reactions: Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, with HNO_2, Schotten – Baumann Reaction. Electrophilic substitution
iv. (case aniline): nitration, bromination, sulphonation.

Diazonium salts:

i. Preparation: from aromatic amines.
ii. Reactions: conversion to benzene, phenol, dyes.

MODULE 7: Amino Acids, Peptides and Proteins: (10 Lectures)

Preparation of Amino Acids: Strecker synthesis using Gabriel's phthalimide synthesis. Zwitterion, Isoelectric point and Electrophoresis.
Reactions of Amino acids: ester of –COOH group, acetylation of $–NH_2$ group, complexation with Cu^{2+} ions, ninhydrin test.
Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins.
Determination of Primary structure of Peptides by degradation Edmann degradation (Nterminal) and C–terminal (thiohydantoin and with carboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) by N-protection (t-butyloxycarbonyl and phthaloyl) & Cactivating groups and Merrifield solid-phase synthesis.

MODULE 8: Carbohydrates: (8 Lectures)

Classification, and General Properties, Glucose and Fructose (open chain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in monosaccharides. Structure of disacharrides (sucrose, cellobiose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation.

Reference Books:

1. Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
2. Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
3. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry, Cengage Learning India Pvt. Ltd.: New Delhi (2009).
4. Mahan, B.H. University Chemistry, 3rd Ed. Narosa (1998).
5. Petrucci, R.H. General Chemistry, 5th Ed., Macmillan Publishing Co.: New York (1985).

6. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
7. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
8. Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
9. Nelson, D. L. & Cox, M. M. Lehninger's Principles of Biochemistry 7th Ed., W. H. Freeman.
10. Berg, J.M., Tymoczko, J.L. & Stryer, L. Biochemistry, W.H. Freeman, 2002.

Course Code	Course Title	Hours per week L-T-P	Credit C
BGENC181317	**Solutions, Phase Equilibria, Conductance, Electro-chemistry & Functional Group Organic Chemistry-II Lab**	**0-0-4**	**2**

Section A: Physical Chemistry

Distribution

Study of the equilibrium of one of the following reactions by the distribution method:

$I_2(aq) + I^-(aq) \quad I_3^-(aq)$

$Cu^{2+}(aq) + xNH_2(aq) \quad [Cu(NH_3)_x]^{2+}$

Phase equilibria

a. Construction of the phase diagram of a binary system (simple eutectic) using cooling curves.
b. Determination of the critical solution temperature and composition of the phenol water system and study of the effect of impurities on it.
c. Study of the variation of mutual solubility temperature with concentration for the phenol water system and determination of the critical solubility temperature.

Conductance

a. Determination of cell constant
b. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.
c. Perform the following conductometric titrations:
    i. Strong acid vs. strong base
    ii. Weak acid vs. strong base

Potentiometry

a. Perform the following potentiometric titrations:
    i. Strong acid vs. strong base
    ii. Weak acid vs. strong base
    iii. Potassium dichromate vs. Mohr's salt

Section B: Organic Chemistry

1. Systematic Qualitative Organic Analysis of Organic Compounds possessing non-functional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.

2.

i. Separation of amino acids by paper chromatography
ii. Determination of the concentration of glycine solution by formylation method.
iii. Titration curve of glycine
iv. Action of salivary amylase on starch
v. Effect of temperature on the action of salivary amylase on starch. 6. Differentiation between a reducing and a nonreducing sugar.

Reference Books:

1. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.
3. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
4. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry, Universities Press.

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