SIES

College of Arts, Science & Commerce

RISE WITH EDUCATION

Sion (West), Mumbai – 400022.

(Autonomous)

Faculty: Science

Program: B.Sc. (Double Majors)

Subject: BIOCHEMISTRY (3 Units)

(INTERDISCIPLINARY)

And

CHEMISTRY (3 Units)

Academic Year: 2019 – 2020

T.Y.B.Sc.

Semester V & VI

Credit Based Semester and Grading Syllabi approved by Board of Studies in Biochemistry and Board of Studies in Chemistry

with effect from 2018-2019

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Preamble

The 3 units Biochemistry course is offered at the third year of B.Sc. program as an interdisciplinary subject along with three units of either Chemistry/ Microbiology/ Botany/ Zoology.

The goal of the 3 Units interdisciplinary Biochemistry course is to build in the learner, the basic foundation of Biochemistry and encourage the student to pursue Biochemistry at higher level.

By the end of the course, a student should be able to:

- Understand both the physical as well as chemical properties of biomolecules
- Explain how proteins, carbohydrates, lipids and nucleic acids contribute to structural integrity of the cell
- Detail on various metabolic and information pathways
- Comprehend the concepts in nutrition and importance of proper nutrition thus laying a foundation for the field of nutrition and dietetics
- Co-relate the properties of biomolecules with their applications in industrial biochemistry
- Learn basic experimental skills in biochemistry and use basic statistics for the analysis of data
- Appreciate the role of computers in biology and get motivated towards learning the ever-expanding fields of Clinical Biochemistry, Genomics, Proteomics and Bioinformatics

T.Y.B.Sc. Biochemistry (3 units) Syllabus

Credit Based Semester and Grading System

To be implemented from the academic year 2018 – 2019

Summary of Course-wise Units of Semester V

Course Code	Unit	Topics	Credits	L/week
SIUSBCH51	NUTRITION, BIOMOLECULES AND BIOPHYSICAL CHEMISTRY-I		2.5	
	I	Basic concepts in nutrition; Carbohydrates		1
	II	Amino acids and Proteins		1
	III	Nucleic acids; Enzymes		1
	IV	Spectroscopy; Centrifugation		1
SIUSBCH52	PHYSIOLOGY, METABOLISM, AND APPLIED BIOCHEMISTRY-I		2.5	
	I	Carbohydrate metabolism		1
	II	Amino acid metabolism; Bioenergetics		1
	III	Plant growth regulators; Endocrinology		1
	IV	Fundamentals of Molecular Biology		1
SIUSBCHP5		Practical of course SIUSBCH51 and SIUSBCH52	3	8

Summary of Course-wise Units of Semester VI

Course Code	Unit	Topics	Credits	L/week
SIUSBCH61	NUTRITION, BIOMOLECULES AND BIOPHYSICAL CHEMISTRY-II		2.5	
	I	Basic concepts in nutrition; Lipids		1
	II	Membrane biochemistry; Concept of pH and Buffers		1
	III	Chromatography		1
	IV	Electrophoresis		1
SIUSBCH62	PHYSIOLOGY, METABOLISM AND APPLIED BIOCHEMISTRY-II		2.5	
	I	Lipid metabolism		1
	II	Basics of Immunology		1
	III	Industrial Biochemistry; Basics of tissue culture		1
	IV	Recombinant DNA technology; Introduction to Bioinformatics		1
SIUSBCHP6		Practical of course SIUSBCH61 and SIUSBCH62	3	8

T.Y.B.Sc.- BIOCHEMISTRY
3 – UNITS INTERDISCIPLINARY SUBJECT
Semester V (SIUSBCH5)

COURSE TITLE: **NUTRITION, BIOMOLECULES AND BIOPHYSICAL CHEMISTRY -I**
COURSE CODE: **SIUSBCH51**
CREDITS: 2.5

Unit No.	Topic No.	Contents	NOL
		Objectives: 1. To comprehend the concepts in nutrition and the importance of proper nutrition, thus laying a foundation for the field of nutrition and dietetics. 2. To help students understand the physico-chemical properties and biochemical role of carbohydrates, proteins and nucleic acids. 3. To lay a strong foundation of concepts in enzyme and enzyme kinetics. 4. To understand the principle, instrumentation and applications of various biophysical techniques like centrifugation and spectroscopy	
I		**Basic Concepts in nutrition ; Carbohydrates**	15
	1.1	**Basic Concepts in human nutrition**: Proximate principles, energy content of food and calorific value	
	1.1.1	Utilization of energy, Units of energy, BMR, factors affecting BMR and its significance. Concept of thermic effect of food (SDA)	
	1.1.2	Physical activity and energy requirements of man.	
	1.2	**Carbohydrates**	
	1.2.1	classification of carbohydrates (mono, oligo & poly) with examples	
	1.2.2	Properties and classification of monosaccharides in terms of – A) functional group and B) Number of carbon atoms	
	1.2.3	Carbohydrate chemistry: Fischers and Haworth formula of glucose Isomers of glucose: D and L, aldose-ketose, optical isomers, epimers and anomers	

	1.2.4	Structure and occurrence of Glucose, Fructose, Galactose, ribose and deoxyribose Disaccharides: maltose, lactose, sucrose	
	1.2.5	Polysaccharides- Classification based on function (storage & structural), composition (homo & hetero) giving examples Storage polysaccharides (Starch and Glycogen), action of amylase on starch. Structural polysaccharides - Cellulose, Chitin	
	1.2.6	Bacterial cell wall polysaccharide: Peptidoglycan framework (With structures of NAG & NAMA), beta lactam antibiotics- Penicillin and cephalosporin	
	1.2.7	Extracellular matrix proteoglycan - Hyaluronate, Chondroitin sulphate and Heparin (monomers and occurrence/Biomedical significance)	
	1.2.8	Nutritional importance of carbohydrates Functions of carbohydrates, Requirement, Dietary sources, Glycemic index, Significance of fiber	
	1.2.9	Commercial importance of carbohydrates: Starch, Cyclodextrin, chitosan, modified cellulose, pectin ;	
II		**Amino acids and Proteins**	15
	2.0	**Amino acids**	
	2.1.1	Classification of amino acids based on the polarity of R-groups (structure of 20 amino acids with three letter and single letter code words)	
	2.2	**Proteins**	
	2.2.1	Proteins: ASBC-APS classification on the basis of shape and function.	
	2.2.2	Structural hierarchy of proteins Primary structure: Formation and characteristics of peptide bond, phi and psi angles Secondary structure: alpha helix- characteristics, forces stabilizing, factors influencing helix stability. Example: keratin beta sheet: characteristics, parallel/ antiparallel, forces stabilizing, example: silk fibroin Tertiary structure - forces stabilizing, example myoglobin Quaternary structure - forces stabilizing, example hemoglobin	
	2.2.3	Primary structure determination Separation of polypeptide chains, breaking disulphide bonds by mercaptoethanol, End group analysis: Sanger reaction, Edman reaction, Dansyl chloride. Cleavage of polypeptide- Trypsin, Chymotrypsin,	

		Pepsin, Aminopeptidase, Carboxypeptidase.	
	2.2.4	Protein denaturation	
	2.2.5	Nutritional significance of proteins Functions of proteins, Requirement, Dietary sources, essential amino acids, Nutritive value of proteins: BV and PER	
III	3.0	**Nucleic acid; Enzymes**	15
	3.1	**Nucleic acids:**	
	3.1.1	Structure of purine and pyrimidine bases, nucleosides and nucleotides, formation of polynucleotide strand with its shorthand representation.	
	3.1.2	RNAs- (various types in pro and eukaryotes), rRNA, t-RNA, m-RNA, their structure and function. Action of alkali on RNA	
	3.1.3	DNA: double helix, Watson –Crick model of DNA and its characteristic features, Forces stabilizing the secondary structure. Structure elucidation: Rosalind Franklin- X-ray diffraction pattern (Physical evidence), Chargaff's rules (Chemical evidence), A, B and Z forms of DNA, Organization of DNA as Chromatin	
	3.1.4	Physical properties of DNA - UV absorption, Hypochromism, Hyperchromism, Denaturation of DNA, Tm.	
	3.2	**Enzymes and Enzyme kinetics**	
	3.2.1	General properties of enzymes, Classification of enzymes- IUB/EC classification (up to I digit)	
	3.2.2	Active site of enzyme, mechanism of action: lock and key, induced fit, transition state theory. Cofactors, Coenzymes (role of vitamins), Prosthetic groups, Apoenzyme and Holoenzyme	
	3.2.3	Enzyme kinetics Factors affecting enzyme-catalysed reaction Derivation of Michaelis- Menten equation, Km, Lineweaver Burk plot, Catalytic efficiency- turn over number, Enzyme activity: Katal, IU Specific activity of enzyme.	
	3.2.4	Enzyme inhibition: Competitive and Noncompetitive.	
IV	4.0	**Centrifugation; Spectroscopy**	15
	4.1	**Centrifugation**	
	4.1.1	General Principle, rpm, RCF, derivation of equation relating RCF and rpm	
	4.1.2	Types of centrifuges and rotors - Clinical, High Speed,	

Ultra –preparative and Analytical

4.1.3 Components and working of - Analytical Ultracentrifuge.

4.1.4 Applications of centrifugation – Use of preparative centrifuge in the separation of cell organelles by differential centrifugation, proteins by rate zonal centrifugation and nucleic acids by isodensity centrifugation.

4.1.5 Use of Analytical Ultracentrifugation in the determination of molecular weights (sedimentation velocity method), conformational studies and purity of a sample.

4.1.6 Numerical problems based on above concepts

4.2 Spectroscopy

4.2.1 General Principle, derivation and limitations of Beer-Lambert law, significance of Lambda max, molar extinction coefficient

4.2.2 Construction and working of simple colorimeter (Single beam) and a spectrophotometer.

4.2.3 Applications of Beer Lambert Law in estimation of Proteins (Biuret method), Sugars (DNSA method).

4.2.4 Numerical problems based on above concepts

Semester V

COURSE TITLE: **PHYSIOLOGY, METABOLISM, AND APPLIED BIOCHEMISTRY-I**

COURSE CODE: **SIUSBCH52**

CREDITS: 2.5

Unit No.	Topic No.	Contents	NOL
		Objectives: 1. To provide an insight about metabolism of carbohydrates and amino acids/proteins 2. To understand the concepts of thermodynamics and its application in living system 3. To study the energy synthesis pathways in plants and animals 4. To study the molecular biology and processes of information transfer 5. To comprehend the role of growth regulators in plants and the chemistry and function of hormones in animals.	
I	1.0	**Carbohydrate metabolism**	15
	1.1	Introduction to metabolism: Catabolism, anabolism, role of high energy phosphates viz. ATP and thioesters, role of reduced coenzymes NADH and NADPH.	
	1.2	Digestion and absorption of carbohydrates Overview of catabolism, Glycogenolysis (Schematic) Catabolism of glucose: Glycolysis- cellular location, sequence of reactions, products, energetics Fate of pyruvate in aerobic and anaerobic conditions. Kreb's cycle: cellular location, sequence of reactions, products, energetics, amphibolic nature.	
	1.3	Anabolism - HMP Shunt (Synthesis of pentose phosphates) -Cellular location, sequence of reactions, oxidative and non-oxidative phases of pathway and multifunctional nature. Gluconeogenesis, Glyoxylate pathway. Glycogenesis (Schematic)	
	1.4	Anaplerotic reactions – Role of Pyruvate carboxylase, PEP carboxykinase, Malic enzyme.	

II **2.0** **Amino acid metabolism; Bioenergetics** **15**

2.1 Amino acids and Protein Metabolism

2.1.1 Digestion and absorption of proteins and amino acids

2.1.2 Catabolism - reactions –Transamination (GOT/GPT and mechanism of transamination)

2.1.3 Decarboxylation of His,Trp, Glu and physiological significance of the products

2.1.4 Deamination: Oxidative (NAD, FAD, FMN-linked oxidases) & Non-oxidative – Asp, Cys, Ser

2.1.5 Urea Cycle - Cellular location, sequence of reactions, labeling of N-atom, formation and transport of ammonia.

2.2 Bioenergetics

2.2.1 **Mitochondrial ETC**

Free energy, free energy change, exergonic and endergonic reactions.
High energy compounds, ATP, Synthesis of ATP, Substrate level and oxidative phosphorylation

Oxidative Phosphorylation:
Electron transport chain: electron carriers, redox potentials, basic chemistry, sequence and location of these electron carriers in mitochondrial membrane, Q cycle.
Inhibitors of ETC:–Antimycin A, Amytal, Rotenone, CN,
Mechanism of ATP synthesis:
Chemiosmotic hypothesis, Proton motive force, Structure of ATPase (F_oF_1 ATPase)

2.2.2 **Photosynthesis**

Light-dependent and Light-independent reactions.
Light dependent reactions, chloroplast, role of reaction center and accessory pigments
Photophosphorylation:
Linear ETC / Z scheme, two reaction centers, production of oxygen and NADPH, proton gradient and ATP synthesis
Cyclic ETC in purple bacteria
Light-independent reactions: Calvin cycle (schematic representation only)

III	**3.0**	**Plant growth regulators; Endocrinology**	**15**
	3.1	**Plant growth regulators:** Role of auxins, cytokinins, abscissic acid, gibberellins and ethylene	
	3.2	**Endocrinology:**	
	3.2.1	Hormones, hormone receptor,	
	3.2.2	classification of hormone on the basis of chemistry, organization of the endocrine system	
	3.2.3	Chemistry, synthesis, secretion and metabolic effects of thyroxine, insulin.	
	3.2.4	Chemistry & physiological role of oxytocin and	
	3.2.5	vasopressin. Physiological role of Glucocorticoids,	
	3.2.6	Epinephrine Endocrine disorders – Diabetes mellitus, Diabetes insipidus, Hypothyroidism (Cretinism & myxedema), Hyperthyroidism (Goitre – Simple & Toxic)	
	3.2.7	Role of second messengers: cAMP, Ca and IP3, Mechanism of action of epinephrine (on glycogenolysis) and steroid hormone (on gene expression).	
IV	**4.0**	**Fundamentals of molecular biology**	**15**
	4.1	**Cell cycle : phases and significance**	
	4.2	**Replication of DNA** - mechanism of replication, modes of DNA replication, experimental evidence for semi-conservative replication, Mechanism, discontinuous DNA synthesis, termination of replication.	
	4.3	**Transcription of DNA** - in prokaryotes, prokaryotic RNA polymerases, Steps in transcription, processing of RNA species, concept of split genes, reverse transcription	
	4.4	**Translation** (protein biosynthesis) in prokaryotes - activation of amino acids, chain initiation, chain elongation, chain termination, post translational modifications of proteins	
	4.5	**Gene regulation**: Promoters, enhancers, Concept of operon, Lac operon	

PRACTICAL based on SIUSBCH51& SIUSBCH52
SIUSBCHP5

Sr No.	Experiments
I	**Preparation of solution** Units for expressing concentration Preparation of solution of given concentration and problems based on the above concepts.
II	**Qualitative Analysis: -** 1.Carbohydrates - Glucose, Fructose, Maltose, Lactose, Sucrose, Starch, Dextrin. 2. Proteins - Albumin, Casein, Gelatin, Peptone.
III	**Estimation of biomolecules** **Volumetric analysis:-** 1.Lactose by Cole's method/Glucose by Benedict's method **Colorimetric analysis: -** 1. Verification of Beer-Lambert law and determination of lambda max of colored solution 2. Soluble proteins by Biuret method 3.RNA by Orcinol method 4. Glucose / Maltose by DNSA method
IV	**Isolation** 1. Starch from potato. 2. Casein from milk
V	**Enzymology** 1. Optimum pH of amylase 2. Amylase: Km of amylase
VI	**Biostatistical analysis:** 1.Collection of data, types of data and presentation 2. Frequency distribution 3. Determination of mean, median and mode
VII	**Demonstration Experiments** 1. Preparation of buffers and use of pH meter 2. Extraction of a phytoconstituent (alkaloid/ flavonoid/pigment) by any one extraction method; distillation, Soxhlet/ solvent 3. Immobilization /entrapment of enzyme (amylase) in alginate 4. Glucose by Folin –Wu method

Semester VI
(SIUSBCH6)

COURSE TITLE: **NUTRITION, BIOMOLECULES AND BIOPHYSICAL CHEMISTRY-II**

COURSE CODE: **SIUSBCH61**
CREDITS: 2.5

Unit No.	Topic No.	Content	NOL

Objectives:

1. To study the basic concepts in nutrition and understand the importance of vitamins and minerals in nutrition.
2. To familiarize the students to the physic-chemical properties and biochemical role of lipids
3. To emphasize on the structure and function of cell membrane and the role of proteins involved in transport of molecules across membrane.
4. To understand the principle, working and applications of various biophysical techniques like chromatography and electrophoresis

I **1.0 Basic Concepts in Nutrition; Lipids** **15**

1.1 Concepts in nutrition:

1.1.1 Energy balance: Normal weight, underweight and obesity, BMI, Nutritional significance of

- vitamins, Deficiency disorders
- Minerals: Fe, Ca, P, Mg

1.2 Lipids

1.2.1 Fatty acids & TAG :
Saturated fatty acids –classification, C2 to C20 (only even C chain fatty acids)
Unsaturated fatty acids – MUFA, PUFA (2,3,4 db), Omega 3, Omega 6 and Omega 9 fatty acids.
Triacylglycerols - Simple and mixed.

1.2.2 Chemical reactions - Saponification, Iodination, Auto-oxidation, Rancidity of fats. Definition and significance - Acid Number, Saponification Number, Iodine Number and Reichert- Meissel Number

1.2.3 Compound lipids –
Structure and function of Glycerophospholipids (Cephalin, Lecithin and Phosphotidyl inositol), Action of Phospholipases Functions of p hosphosphingolipids (ceramide, Sphingomyeline), Glycolipids or Cerebrosides (Galacto and Glucocerebrosides)

1.2.4 Steroids and Lipoproteins
Steroids - Cholesterol structure and biochemical significance
Lipoproteins –Types (Chylomicron, VLDL, LDL, HDL) and biochemical significance.

1.2.5 Nutritional significance of lipids

II 2.0 Membrane biochemistry ; Concept of acids, bases and buffers 15

2.1 **Membrane biochemistry**

2.1.1 Biological membrane -Membrane constituents and assembly: Fluid-mosaic model, Lipid bilayer, asymmetric distribution of lipids Membrane

2.1.2 proteins : integral/transmembrane, Lipid-linked and peripheral

2.1.3 Erythrocyte membrane model

2.1.4 Membrane transport:
Active and Passive, pumps and channels Na^+ – K^+ pump, inhibitors, Secondary transporters- antiporters, symporters.

2.2 **Concept of acids, bases and buffers**

2.2.1 Water –properties and role, dissociation and ionic Product.

2.2.2 Acids and bases, hydrogen ion concentration and pH, dissociation, Hendersen –Hasselbalch equation Titration curve of acetic acid, pKa value.

2.2.3 Ionization and titration curve of ala, Gly, Lys and Asp, pI and pKa values of these amino acids.

2.2.4 Importance of pH in cells,
Buffers, buffer value/capacity, common laboratory buffers, physiological Buffers (Carbonate buffer, phosphate buffer and protein buffer).

2.2.5 Numerical problems based on above concepts.

III	**3.0**	**Chromatography**	**15**
	3.1	**Chromatography :** Principle, requirements, technique and applications of - Partition chromatography (Paper), Adsorption chromatography (TLC and Column), Ion exchange chromatography (Column) and Gel filtration chromatography.	
	3.2	Introduction to GLC, HPLC and Affinity Chromatography -Principles only.	
	3.4	Numerical problems based on above concepts.	
IV	**4.0**	**Electrophoresis**	**15**
	4.1	Principles of electrophoresis, factors affecting the Electrophoretic mobility.	
	4.2	Types of electrophoresis: Moving boundary, Zone electrophoresis (horizontal), set up, Support media (paper, cellulose acetate, agar, agarose and polyacrylamide), technique, detection and recovery.	
	4.3	PAGE: Native and SDS, discontinuous electrophoresis for separation of proteins.	
	4.4	Applications of electrophoresis - Separation of proteins and nucleic acids, Purity determination, Molecular weight determination using PAGE.	
	4.5	Isoelectric focusing	

Semester VI

COURSE TITLE: **PHYSIOLOGY, METABOLISM, AND APPLIED BIOCHEMISTRY-II**
COURSE CODE: **SIUSBCH62**
CREDITS: 2.5

Unit No.	Topic No.	Contents	NOL
		Objectives: 1. To study biochemical oxidation and synthesis of fats 2. To understand the basics of immunology 3. To familiarize the students to bioprocess technology and its applications 4. To study the basic techniques of tissue culture 5. To study recombinant DNA technology and its applications 6. To introduce the field of bioinformatics and make understand the scope, applications and potentials of bioinformatics.	
I	1.0	**Lipid metabolism**	15
	1.1	Digestion and absorption of lipids	
	1.2	Catabolism - Knoop's experiment, Beta – oxidation of even carbon saturated fatty acids, role of carnitine, energetics from C4 to C20	
	1.3	Anabolism - Fatty acid biosynthesis (only Palmitic acid), fatty acyl synthetase complex.	
	1.4	Ketone bodies formation, utilization. Ketosis, physiological significance in Diabetes mellitus, starvation, alcoholism and pregnancy.	
	1.4	Lipoprotein metabolism.	
II	2.0	**Basics of immunology**	15
	2.1	Immunity, antigen, hapten and antibody. Types of immunity: Innate, Acquired, Active and Passive Innate immunity: External barriers, Phagocytosis, Complement, Natural Killer cells	
	2.2	Acquired immunity: Humoral and Cell-mediated Specificity, Self-Nonself recognition Humoral immunity: B cells, plasma cells, functions of antibody. Cell-mediated: T cells, subsets-T helper and cytotoxic T cells, MHC – class I and II.	
	2.3	Cells and organs of immune system.	

2.4 Immunoglobulins general structure, classes and sub-Classes- their structure and functions.

2.5 Antigen– antibody reactions - Precipitation and agglutination.

III 3.0 Industrial biochemistry ; Tissue culture techniques **15**

3.1 Bioprocess technology – Introduction, Steps in setting
3.1.1 up an industrial process, parameters, Selection of organism, screening, types of media, Batch and continuous fermentation, Basic components of a typical fermenter, Downstream processing

3.1.2 Applications

3.1.3 Fermentation process for production of alcohol/wine/beer

3.2 Tissue Culture: Plant and Animal

3.2.1 Requirements: Physical conditions, Nutritional requirements, General technique, explant, callus, totipotency, dedifferentiation, redifferentiation, role of plant growth regulators.

3.2.2 Different types of tissue culture techniques, protoplast fusion

3.2.3 Applications of tissue culture

IV 4.0 Recombinant DNA technology; Introduction to bioinformatics **15**

4.1 Recombinant DNA technology

4.1.1 Genetic engineering – Steps in DNA cloning, Restriction enzymes, Isolation of gene from cellular chromosomes, Cloning vectors (Plasmid, Phage, Cosmid, Improved vectors, and shuttle vectors), transformation, and selection of recombinant cells.

4.1.2 Cloning of insulin gene

4.1.3 Transgenic plants – Bt cotton, Cloning in plants using Ti plasmid.

4.1.4 Gene libraries, DNA probes

4.1.5 DNA amplification by PCR, applications of PCR

4.1.6 Applications of recombinant DNA technology.

4.2 Introduction to bioinformatics

4.2.1 History of Bioinformatics, Genomics and Proteomics

4.2.2 Databases- types – Public domain database, Sequence database, Structural database, Motif database, Genome database, Proteome database, Annotated sequence database – Gen Bank, EMBL, PIR, SWISS PROT, PDB, GDB.

4.2.3 Sequence analysis Tools - BLAST, FASTA, L-ALIGN, CLUSTAL-X & W, RASMOL, Software for protein sequencing - PROPECT, AMMP, COPIA

4.2.4 Applications of Bioinformatics in – Sequence analysis, Molecular modeling and drug designing, Phylogeny/evolution, Ecology & population studies, Medical informatics and agriculture.

4.2.5 Micro-array analysis-concept

PRACTICALS based on SIUSBCH61 & SIUSBCH62
SIUSBCHP6

S.No.	Experiments
I	**Isolation** 1. Isolation of DNA and detection
II	**Food analysis** **Mineral Estimation :-** Preparation of food ash 1. Calcium by EDTA method 2. Iron by Wongs method 3. Phosphorus by Fiske-Subbarow method **Vitamin estimation** 1. Estimation of vitamin C / V itamin B1 2. Tests for lipid quality: Acid number
III	**Chromatography** 1. Circular paper chromatography of amino acids 2. Circular paper chromatography of sugars
IV	**Antigen-antibody reactions** Immunodiffusion (Precipitation)
V	**Microbiology** 1. Monochrome, Gram and negative staining 2. Isolation of bacteria : streaking and spreading
VI	**Biostatistical analysis (measures of dispersion)** Determination of SD and variance
VII	**Demonstration Experiments:-** 1. Separation of DNA by agarose gel electrophoresis 2. Column chromatography - separation of chlorophylls 3. Agglutination reaction: Blood grouping or Widal qualitative 4. 2D paper/2D TLC chromatography of complex mixture of amino acids/sugars 5. Preparation of media 6. Bioinformatics: Sequence retrieval, Introduction to protein structure database

SCHEME OF EXAMINATION

Biochemistry, as an interdisciplinary subject, consists of 03 (Three) Units of T.Y.B.Sc. carrying 600 marks as follows :

THEORY				
COURSE CODE	**Title of Paper**	**Internal Assessment marks**	**Semester end Examination marks**	**Total Marks**
SIUSBCH51	Nutrition, Biomolecules and Biophysical Chemistry I	40	60	100
SIUSBCH52	Physiology, Metabolism and Applied Biochemistry I	40	60	100
	TOTAL			**200**
SIUSBCH61	Nutrition, Biomolecules and Biophysical Chemistry II	40	60	100
SIUSBCH62	Physiology, Metabolism and Applied Biochemistry II	40	60	100
	TOTAL			**200**

PRACTICAL		
COURSE CODE	**Marks per course**	**Total per semester**
SIUSBCH5	100 for SIUSBCH51 and SIUSBCH52	**100**
SIUSBCH6	100 for SIUSBCH61 and SIUSBCH62	**100**
TOTAL		**200**

SCHEME OF PRACTICAL EXAMINATION
SEMESTER V

Course SIUSBCHP5	Experiments	Marks
	a. Isolation	20
	b. Estimation of biomolecule: Colorimetry/ Volumetry	15
	c. Enzymology	20
	d. Spots (Statistical analysis -10M; Qualitative and Demonstration experiments-15M)	25
	e. Certified Journal*	10
	f. *Viva voce*	10
	TOTAL	**100**

* Candidate without duly certified Journals **shall not** be allowed to appear for the University Practical Examination.

1. The Sem V practical examination shall be conducted by the college
2. There shall be 02 (Two) examiners to conduct the practical examination, one Internal examiner and other external examiner
3. The external examiner shall be on the panel of examiner
4. The college shall invite one such examiner from approved panel as an external examiner
5. Duration for the Practical examination for Sem V
   a) One day of 02 sessions of 3 ½ hours each
   b) Morning session: 09.00 am to 12.30 pm
      Afternoon session: 01.00 pm to 4.30 pm

SCHEME OF PRACTICAL EXAMINATION

SEMESTER VI

Course SIUSBCHP6	Experiments	Marks
	a. Chromatography	20
	b. Colorimetric Analysis/Isolation of DNA	15
	c. Volumetric Analysis	15
	d. Spots (statistical Analysis – 15 M; Microbiology, Immunodiffusion and Demonstration- 15M)	30
	e. Certified Journal*	10
	f. Viva voce	10
	TOTAL	**100**

* Candidate without duly certified Journals **shall not** be allowed to appear for the Sem end Practical Examination.

1. The Sem VI practical examination shall be conducted by the College.
2. There shall be 02 (Two) examiners, one internal and other appointed from the panel of approved examiners.
3. Duration for the Practical examination for Sem VI

a) One day of 02 sessions of 3 ½ hours each
b) Morning session: 09.00 am to 12.30 pm
c) Afternoon session: 01.00 pm to 4.30 pm.

I. Scheme of Examination for Third year Science Undergraduate

External Examination : 60%
Internal Examination : 40%

A. Scheme of External Theory examination at TYBsc. (Sem V and Sem VI)

1) Each theory paper shall carry **60 marks**
2) Each theory paper shall be **2 hours** duration
3) Each theory paper shall contain **04 questions of 15 marks each** as follows: -

Q1 Based on Unit I
Q2 Based on Unit II
Q3 Based on Unit III
Q4 Based on Unit IV

4) Marking system for **Questions I to IV**

Sub Q A: Attempt any three out of four (Objectives/MCQs)------- 03marks each

Sub Q B: Attempt any one out of two ------- 02 marks each

Sub Q C: Attempt any one out of two ------- 04marks each

Sub Q D: Attempt any one out of two ------- 06 marks each

B. Internal Assessment:

Sr. No.	Particulars	40 Marks
1	ONE class test to be conducted in the given semester (Objectives and /or MCQs/answer in one or two sentences: 20M)	20 Marks
2	One activity/oral presentation/assignment based on curriculum/ report etc.to be assessed by the teacher	20 Marks

C. For Courses with Practical: There will not be any Internal Examination for practicals

D. External Examination for practicals:

Sr. No.	Particulars for External Practical Examination		Marks
	Particulars for External Practical Examination Semester End		100 Marks
1	Laboratory	80 Marks	
2	Journal	10 Marks	
3	Viva	10 Marks	

II. Educational tour /Industrial Visit

It is recommended that the TYBSc students be taken for an Educational tour / Industrial visit in Mumbai /Maharashtra/ other States in India to visit various Universities/ research centers/Industries (Pharma, Food, chemical, Biochemical, Beverages, Oil, etc.) to give first-hand knowledge of current trends in research and the exposure to the working of industry, academia and research centers.

A summary report of this Educational tour / Industrial visit may be evaluated for 10 marks as a part of the 20 marks activity-based internal assessment.

Suggested Reading

1. Nelson, D. L., Lehninger, A. L., & Cox, M. M. (2008). *Lehninger principles of biochemistry*. Macmillan.
2. Voet, D., Voet, J. G., & Pratt, C. W. (2016). Fundamentals of biochemistry: life at the molecular level. John Wiley & sons.
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18. Joshi, S. A. (1995). *Nutrition and dietetics*. McGraw-Hill Education.
19. Srilakshmi, B. (2006). *Nutrition Science*. New Age International.
20. Lewin, B. (2004). *genes VIII* (No. 04; QH430, L4.
21. Russell, P. J., & Gordey, K. (2002). *IGenetics* (No. QH430 R87). San Francisco: Benjamin Cummings.
22. Owen, J. A., Punt, J., & Stranford, S. A. (2013). *Kuby immunology* (p. 692). New York: WH Freeman.
23. Delves, P. J., Martin, S. J., Burton, D. R., & Roitt, I. M. (2017). *Essential immunology*. John Wiley & Sons.
24. Gajera, H. P., Patel, S. V., & Golakiya, B. A. (2008). *Fundamentals Of Biochemistry Textbook Student Edition*. IBDC Publishers.
25. Casida, L. E. (1968). Industrial microbiology. *Industrial microbiology.*
26. Mahajan, B. K., & Lal, S. (1999). Methods in biostatistics for medical students and research workers. *Indian Journal of Community Medicine*, *24*(03), 140.
27. Rastogi, S. C., Rastogi, S. C., Mendriratta, N., & Rastogi, P. (2006). *Bioinformatics: Concepts, Skills & Applications*. CBS Publishers & Distributors Pvt. Limited.
28. Jogdand, S. N. (2010). *Environmental biotechnolog*. Himalaya Pub. House,
29. Gupta, P. K. (1994). *Elements of biotechnology*. Rastogi publications.
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SIES

College of Arts, Science & Commerce

RISE WITH EDUCATION

Sion (West), Mumbai – 400022.

(Autonomous)

Department of Chemistry

Program: B.Sc.

Course: Chemistry (3 Units)

Syllabus for T.Y.B.Sc. Semester V & VI

(Implemented from 2019 – 2020)

Credit Based Semester and Grading System

SEMESTER – V

Contents:		
Paper I		
Section I	:	**Physical Chemistry**
SIUSCHE3U51.1	:	Molecular Spectroscopy
SIUSCHE3U51.2	:	Chemical Thermodynamics and Chemical Kinetics
Section II	:	**Inorganic Chemistry**
SIUSCHE3U51.3	:	Molecular Symmetry and Chemical Bonding
SIUSCHE3U51.4	:	Chemistry of Inner transition elements
Paper II		
Section I	:	**Organic Chemistry**
SIUSCHE3U52.1	:	Mechanism of organic reactions and photochemistry
SIUSCHE3U52.2	:	Stereochemistry, Agrochemicals and Heterocyclic chemistry
Section II	:	**Analytical Chemistry**
SIUSCHE3U52.3	:	Introduction to quality concepts, chemical calculations and sampling
SIUSCHE3U52.4	:	Optical methods
Practical		
SIUSCHE3U5P1	:	Chemistry Practical

SEMESTER – VI

Contents:		
Paper I		
Section I	:	**Physical Chemistry**
SIUSCHE3U61.1	:	Electrochemistry
SIUSCHE3U61.2	:	Polymers
Section II	:	**Inorganic Chemistry**
SIUSCHE3U61.3	:	Theories of metal-ligand bond (I)
SIUSCHE3U61.4	:	Organometallic Chemistry
Paper II		
Section I	:	**Organic Chemistry**
SIUSCHE3U62.1	:	Stereochemistry II, Amino acids & Proteins
SIUSCHE3U62.2	:	Molecular Rearrangement& Carbohydrates
Section II	:	**Analytical Chemistry**
SIUSCHE3U62.3	:	Electro Analytical Techniques
SIUSCHE3U62.4	:	Food And Cosmetics Analysis
Practical		
SIUSCHE3U6P1	:	Chemistry Practical

T.Y.B.Sc. Chemistry Syllabus

SEMESTER V

Course Code	Unit	Topics	Credits	L/Week
SIUSCHE3U51	1	**Molecular Spectroscopy**	2.5	1
		1.1 Molecular Spectroscopy (15L)		
	2	**Chemical Thermodynamics and Chemical kinetics**		1
		2.1 Chemical Thermodynamics (10L)		
		2.2 Chemical kinetics (5L)		
	3	**Molecular Symmetry and Chemical Bonding**		1
		3.1 Molecular Symmetry (6L)		
		3.2 Molecular Orbital Theory for heteronuclear diatomic molecules and polyatomic species (9L)		
	4	**Chemistry of inner transition elements**		1
		4.1 Inner transition elements (5L)		
		4.2 Lanthanide series (10L)		
SIUSCHE3U52	1	**Mechanism of organic reactions and photochemistry**	2.5	1
		1.1 Mechanism of organic reactions		
		1.2 Photochemistry		
	2	**Stereochemistry, Agrochemicals & Heterocyclic chemistry**		1
		2.1 Stereochemistry I (5 L)		
		2.2 Agrochemicals (4 L)		
		2.3 Heterocyclic chemistry (6 L)		

	3	**Introduction to quality concepts, chemical calculations and sampling**		**1**
		3 .1 Quality in Analytical Chemistry (5 L)		
		3.2 Chemical Calculations (4 L)		
		3.3 Sampling (6 L)		
	4	**Optical methods**	**2.5**	**1**
		4.1 Atomic Spectroscopy: Flame Emission spectroscopy (FES) and Atomic Absorption Spectroscopy (AAS) (7L)		
		4.2 Molecular Fluorescence and Phosphorescence Spectroscopy (4L)		
		4.3. Turbidimetry and Nephelometry (4L)		
SIUSCHE3U5P1	**1**	**Physical and Analytical Chemistry Practical**	**3**	**8**
	2	**Inorganic and Organic Chemistry Practical**		

Course Code: SIUSCHE3U51

Paper I

Credits: 2.5 Credits (60 Lectures)

Section I		
Unit – 1, 1L/Week		**15L**
Course Code: SIUSCHE3U51.1 **LEARNING OBJECTIVES** 1. *To study the role of spectroscopy in determining the dipole moment of molecules.* 2. *To study interpret rotational, vibration and IR spectrum of diatomic molecule.* 3. *To interpret Raman spectra considering examples of various molecules.*		
Note : Numericals and Word Problems are Expected from All Units		
1 Molecular Spectroscopy		**15 L**
1.1	**Molecular Spectroscopy** 1.1.1 Rotational Spectrum: Introduction to dipole moment, polarization of a bond, bond moment, molecular structure, Rotational spectrum of a diatomic molecule, rigid rotor, moment of inertia, energy levels, conditions for obtaining pure rotational spectrum, selection rule, nature of spectrum, determination of internuclear distance and isotopic shift. 1.1.2 Vibrational spectrum: Vibrational motion, degrees of freedom, modes of vibration, vibrational spectrum of a diatomic molecule, simple harmonic oscillator, energy levels, zero point energy, conditions for obtaining vibrational spectrum, selection rule, nature of spectrum. 1.1.3 Vibrational-Rotational spectrum of diatomic molecule: Energy levels, selection rule, nature of spectrum, P and R branch lines. Anharmonic oscillator - energy levels, selection rule, fundamental band, overtones. Application of vibrational-rotational spectrum in determination of force constant and its significance. Infrared spectra of simple molecules like H_2O and CO_2. 1.1.4 Raman Spectroscopy : Scattering of electromagnetic radiation, Rayleigh scattering, Raman scattering, nature of Raman spectrum, Stoke's lines, anti-Stoke's lines, Raman shift, quantum theory of Raman spectrum, comparative study of IR and Raman spectra, rule of mutual exclusion- CO_2 molecule.	**15 L**
Unit – 2, 1L/Week		**15 L**
Course Code: SIUSCHE3U51.2 **LEARNING OBJECTIVES** 1. *To have a basic understanding of colligative properties with their applications.*		

2. *To study the applications of collision theory to unimolecular and bimolecular reactions.* 3. *To classify reactions as slow, fast and ultra-fast, study the kinetics of fast reactions.*		
2 Chemical Thermodynamics and Chemical kinetics		**15 L**
2.1	**Chemical Thermodynamics** 2.1.1 Colligative properties: Vapour pressure and relative lowering of vapour pressure. Measurement of lowering of vapour pressure - Static and Dynamic method 2.1.2 Solutions of Solid in Liquid: Elevation in boiling point of a solution, thermodynamic derivation relating elevation in boiling point of the solution and molar mass of non-volatile solute. Depression in freezing point of a solution, thermodynamic derivation relating the depression in the freezing point of a solution and the molar mass of the non-volatile solute. Beckmann Method and Rast Method. 2.1.3 Osmotic Pressure : Introduction, thermodynamic derivation of Van't Hoff equation, Van't Hoff Factor. Measurement of Osmotic Pressure - Berkeley and Hartley's Method, Reverse Osmosis.	**10 L**
2.2	**Chemical kinetics** 2.2.1. Collision theory of reaction rates: Application of collision theory to 1. Unimolecular reaction Lindemann theory and 2. Bimolecular reaction. (derivation expected for both) 2.2.2 Classification of reactions as slow, fast and ultra -fast. Study of kinetics of fast reactions by Stop flow method and Flash photolysis (No derivation expected).	**5 L**
Section II		
Unit – 3, 1L/Week		**15 L**
Course Code: SIUSCHE3U51.3 **LEARNING OBJECTIVES** 1. *To study the symmetry of inorganic molecules.* 2. *To learn the concepts of point groups.* 3. *To study the geometry and structural behavior of polyatomic species on the basis of Walsh correlation diagram, study LCAO and MO, SALC's of heteroatomic molecules.*		
3 Molecular symmetry, MOT of polyatomic species & metallic bond		**15 L**

3.1	**Molecular Symmetry:** 3.1.1 Introduction and Importance of symmetry in chemistry. 3.1.2 Symmetry elements and symmetry operations. 3.1.3 Concept of a Point Group with illustrations using the following point groups (i) $C_{\infty v}$ (HCl) (ii) $D_{\infty h}$ (H_2) (iii) C_{2v} (H_2O) (iv) C_{3v} (NH_3) (v) C_{2h} (trans-trichloroethylene) and (vi) $D_{3h}(BCl_3)$	**6 L**
3.2	**Molecular Orbital Theory for heteronuclear diatomic molecules and polyatomic species :** 3.2.1 Comparision between homonuclear and heteronuclear diatomic molecules. 3.2.2 Heteronuclear diatomic molecules like CO, NO and HCl, appreciation of modified MO diagram for CO. 3.2.3 Molecular orbital theory for H_3 and H_3^+ (correlation diagram expected) 3.2.4 Molecular shape to molecular orbital approach in AB_2 molecules. Application of symmetry concepts for linear and angular species considering σ-bonding on. Examples like: i) BeH_2 ii) H_2O	**9 L**
Unit – 4, 1L/Week		**15 L**
Course Code: SIUSCHE3U51.4 **LEARNING OBJECTIVES** 1. *To study the position of inner transition elements in periodic table.* 2. *To study the shapes of f-orbitals, discuss the properties of lanthanides and actinides.* 3. *Introduce the elution order with respect to basicity through solvent extraction and ion exchange methods for lanthanide separations.*		
4 Chemistry of Inner transition elements		**15 L**
4.1	**Inner transition elements** **4.1.1** Introduction: position of f-block elements, electronic configuration of lanthanides and actinides and comparison between lanthanides and actinides **4.1.2** The shapes of *f*-orbitals.	**5 L**
4.2	**Lanthanides Series** 4.2.1 Chemistry of lanthanides with reference to (i) lanthanide contraction and its consequences (ii) Oxidation states (iii) Ability to form complexes (iv) Magnetic and spectral properties. 4.2.2 Occurrence, extraction and separation of lanthanides by (i) Ion exchange method (ii) Solvent extraction method (Principles and technique). 4.2.3 Applications of lanthanides.	**10 L**

Course Code: SIUSCHE3U52

Paper II

Credits: 2.5 Credits (60 Lectures)

Section I		
Unit – 1, 1L/Week		**15L**
Course Code: SIUSCHE3U52.1 **LEARNING OBJECTIVES** 1. *Recapitulation of basic concept and terminology with respect to reaction mechanism.* 2. *The evidences, mechanism & stereochemical aspects of substitution and elimination reactions.* 3. *To study the concept of pericyclic reactions.* 4. *To know the difference between thermal and photochemical reactions.* 5. *To study the Jablonski diagram and various types of photochemical reactions.*		
1 Mechanism of organic reactions and photochemistry		
1.1	**Mechanism of organic reactions** 1.1.1 The basic terms and concepts: bond fission, reaction intermediates, electrophiles & nucleophiles, ligand, base, electrophilicity vs acidity and nucleophilicity vs basicity. 1.1.2 Neighbouring group participation in nucleophilic substitution reactions**:** participation of lone pair of electrons, kinetics and stereochemical outcome. 1.1.3 Acyl nucleophilic substitution (Tetrahedral mechanism): Acid catalyzed esterification of carboxylic acids ($A_{AC}2$) and base promoted hydrolysis of esters ($B_{AC}2$). 1.1.4 Pericyclic reactions, classification and nomenclature 1.1.4.1 Electrocyclic reactions (ring opening and ring closing), cycloaddition, sigma tropic Rearrangement, group transfer reactions, cheletropic reaction (definition and one example of each type) 1.1.4.2 Pyrolytic elimination: Cope, Chugaev, pyrolysis of acetates.	**10L**
1.2	**Photochemistry** 1.2.1 Introduction: Difference between thermal and photochemical reactions. Jablonski diagram, singlet and triplet states, allowed and forbidden transitions, fate of excited molecules, photosensitization. 1.2.2 Photochemical reactions of olefins: photoisomerization, photochemical rearrangement of 1,4-dienes (di- π methane)	**5L**

	1.2.3 Photochemistry of carbonyl compounds: Norrish I, Norrish II cleavages. Photo reduction (e.g. benzophenone to benzopinacol)	
Unit – 2, 1L/Week		**15 L**
Course Code: SIUSCHE3U52.2 **LEARNING OBJECTIVES** 1. *To study the concept of chirality and chiral axes.* 2. To learn the concept, synthesis and applications of agrochemicals. 3. *To learn the basic aspects of heterocyclic compounds.* 4. *To study synthesis and reactions of quinoline, iso-quionoline and pyridine-N-oxide.*		
2 Stereochemistry, Agrochemicals & Heterocyclic chemistry		**15 L**
2.1	**Stereochemistry I:** 2.1.1 Molecular chirality and elements of symmetry: Mirror plane symmetry, inversion center, rotation-reflection (alternating) axis. 2.1.2 Chirality of compounds without a stereogenic center: cummulenes and biphenyls.	**5 L**
2.2	**Agrochemicals:** 2.2.1 General introduction and scope, meaning and examples of insecticides, herbicides, fungicide, rodenticide, pesticides, plant growth regulators. 2.2.2 Advantages and disadvantages of agrochemicals. 2.2.3 Synthesis and application of IAA(Indole Acetic Acid) and Endosulphan. 2.2.4 Bio pesticides – Neem oil and Karanj oil.	**4 L**
2.3	**Heterocyclic chemistry:** 2.3.1 Reactivity of pyridine-N-oxide, quinoline and iso-quionoline. 2.3.2 Preparation of pyridine-N-oxide, quinoline (Skraup synthesis) and iso-quinoline (Bischler-Napieralski synthesis). 2.3.3 Reactions of pyridine-N-oxide: halogenation, nitration and reaction with $NaNH_2$/liq.NH_3, n-BuLi. 2.3.2 Reactions of quinolone and isoquinoline; oxidation, reduction, nitration, halogenation and reaction with $NaNH_2$/liq.NH_3, n-BuLi.	**6L**
Section II		
Unit – 3, 1L/Week		**15 L**
Course Code: SIUSCHE3U52.3 **LEARNING OBJECTIVES**		

1. *To introduce the learner with various treatments on analytical data for accurate analysis* 2. *To make the learner capable of solving problems.* 3. *To give the learner an opportunity to get hands on experience in sampling of solid, liquid and gaseous samples*		
3 Introduction to Quality Concepts, Chemical Calculations and Sampling		**15 L**
3.1	**Quality in Analytical Chemistry** 3.1.1 Concepts of Quality, Quality Control and Quality Assurance. 3.1.2 Importance of Quality concepts in Industry. 3.1.3 Chemical Standards and Certified Reference Materials; Importance in chemical analysis. Quality of material: Various grades of laboratory reagents.	**5 L**
3.2	**Chemical Calculations** (Numericals and word problems are expected) 3.2.1 Inter conversion of various concentration units. (Conversion of concentration from one unit to another unit with examples) 3.2.2 Percent composition of elements in chemical compounds.	**4 L**
3.3	**Sampling** 3.3.1 Purpose, significance and difficulties encountered in sampling. 3.3.2 Sampling of solids: Sample size – bulk ratio, size to weight ratio, multistage and sequential sampling, size reduction methods, sampling of compact solids, equipments and methods of sampling of compact solids, sampling of particulate solids, methods and equipments used for sampling of particulate solids. 3.3.3 Sampling of liquids: Homogeneous and heterogeneous, Static and flowing liquids. 3.3.4 Sampling of gases: Ambient and stack sampling: Apparatus and methods for sampling of gases. 3.3.5 Collection, preservation and dissolution of the sample.	**6 L**
Unit – 4, 1L/Week		**15 L**
Course Code: SIUSCHE3U52.4 **LEARNING OBJECTIVES** 1. *To introduce learner with various optical methods of analysis.* 2. *To study Fluorescence and Phosphorescence phenomenon and its applications.* 3. *To study the Nephelometry and Turbidimetry and its applications.*		

4 Optical methods		**15 L**
4.1	**Atomic Spectroscopy: Flame Emission spectroscopy(FES) and Atomic Absorption Spectroscopy(AAS)** 4.1.1 Introduction, Energy level diagrams, Atomic spectra, Absorption and Emission Spectra. 4.1.2 Flame Photometry – Principle, Instrumentation (Flame atomizers, types of Burners, Wavelength selectors, Detectors). 4.1.3 Atomic Absorption Spectroscopy – Principle, Instrumentation (Source, Chopper, Flame and Electrothermal Atomiser). 4.1.4 Quantification methods of FES and AAS – Calibration curve method, Standard addition method and Internal standard method. 4.1.5 Comparison between FES and AAS. 4.1.6 Applications, Advantages and Limitations.	**7 L**
4.2	**Molecular Fluorescence and Phosphorescence Spectroscopy** 4.1.2 Introduction and Principle. 4.2.2 Relationship of Fluorescence intensity with concentration. 4.2.3 Factors affecting Fluorescence and Phosphorescence. 4.2.4 Instrumentation and applications. 4.2.5 Comparison of Fluorimetry and Phosphorimetry. 4.2.6 Comparison with Absorption methods.	**4L**
4.3	**Turbidimetry and Nephelometry** 4.3.1 Introduction and Principle. 4.3.2 Factors affecting scattering of Radiation: Concentration, particle size, wavelength, refractive index. 4.3.3 Instrumentation and Applications.	**4L**

SUGGESTED REFERENCE SIUSCHE3U51

Section I

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2. Physical Chemistry, P.C. Rakshit, 6th Edition, 2001, Sarat Book Distributors, Kolkota.
3. Physical Chemistry, R.J. Silbey, & R.A. Alberty, 3rd edition , John Wiley & Sons, Inc [part 1]
4. Physical Chemistry, G. Castellan, 3rd edition, 5th Reprint, 1995 Narosa Publishing House.
5. Modern Electrochemistry, J.O.M Bockris & A.K.N. Reddy, Maria Gamboa – Aldeco 2nd Edition, 1st Indian reprint,2006 Springer
6. Fundamental of Molecular Spectroscopy, 4th Edn., Colin N Banwell and Elaine M McCash Tata McGraw Hill Publishing Co. Ltd. New Delhi, 2008.

7. Physical Chemistry, G.M. Barrow, 6th Edition, Tata McGraw Hill Publishing Co. Ltd. New Delhi. The Elements of Physical Chemistry, P.W. Atkins, 2nd Edition, Oxford Universtity Press Oxford.
8. Physical Chemistry, G.K. Vemullapallie, 1997, Prentice Hall of India, Pvt.Ltd. New Delhi.
9. Principles of Physical Chemistry B.R. Puri, L.R. Sharma, M.S. Pathania, VISHAL PUBLISHING Company, 2008.
10. Textbook of Polymer Science, Fred W Bilmeyer, John Wiley & Sons (Asia) Ple. Ltd., Singapore, 2007.
11. Polymer Science, V.R. Gowariker, N.V. Viswanathan, Jayadev Sreedhar, New Age International (P) Ltd., Publishers, 2005.
12. Essentials of Nuclear Chemistry, Arnikar, HariJeevan , New Age International (P) Ltd., Publishers, 2011.
13. Chemical Kinetics,K. Laidler, Pearson Education India, 1987.

Section II

1. Lesley E. Smart, Elaine A. Moore Solid State Chemistry: An Introduction, 2nd Edition CRC Press,
2. C. N. R. Rao Advances in Solid State Chemistry
3. R.G. Sharma Superconductivity: Basics and Applications to Magnets
4. Michael Tinkham ,Introduction to Superconductivity: Vol I (Dover Books on Physics)
5. R. Gopalan, Inorganic Chemistry for Undergraduates, Universities Press India.
6. Satya Prakash, G.D.Tuli, R.D. Madan, Advanced Inorganic Chemistry.S. Chand & Co Ltd.
7. Cotton, Wilkinson, Murillo and Bochmann, Advanced Inorganic Chemistry, 6th Edition.
8. Greenwood, N.N. and Earnshaw, Chemistry of the Elements, Butterworth Heinemann. 1997.
9. Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993.
10. G. Singh, Chemistry of Lanthanides and Actinides, Discovery Publishing House
11. Simon Cotton , Lanthanide and Actinide Chemistry Publisher: Wiley-Blackwell
12. B. H. Mahan, University Chemistry, Narosa publishing.
13. R. Gopalan, Inorganic Chemistry for Undergraduates, Universities Press India.
14. J. D. Lee, Concise Inorganic Chemistry, 4thEdn., ELBS,
15. D. F. Shriver and P. W. Atkins, Inorganic chemistry, 3rd edition, Oxford University Press
16. Cotton, Wilkinson, Murillo and Bochmann, Advanced Inorganic Chemistry, 6th Edition.
17. Gary Wulfsberg, Inorganic chemistry, Viva Books Pvt,.Ltd. (2002).
18. Richard Harwood, Chemistry, chapter 10 Industrial inorganic chemistry
19. Greenwood, N.N. and Earnshaw, Chemistry of the Elements, Butterworth Heinemann. 1997.

SUGGESTED REFERENCE SIUSCHE3U52

Section I

1. A guidebook to mechanism in Organic Chemistry, 6th edition, Peter Sykes, Pearson education, New Delhi
2. Organic Reaction Mechanism, 4th edition, V. K. Ahluwalia, R. K. Parashar, Narosa Publication.
3. Organic reactions & their mechanisms, 3rd revised edition, P.S. Kalsi, New Age International Publishers.
4. Organic Chemistry, 7th Edition, R.T. Morrison, R. N. Boyd & S. K. Bhattacharjee, Pearson.
5. Organic chemistry, 8th edition, John McMurry.
6. M.B. Smith and J. March, Advanced organic chemistry- reactions mechanism and structure, 5th edition.
7. Frontier Orbital and Symmetry Controlled Pericyclic Reactions, Dr. Ratan Kumar Kar, Published by Books & Allied (P) Ltd./New India Book Agency, New Delhi. Latest Edition from September 2013.
8. Photochemistry and Pericyclic reaction, Jagdhamba, 3rd Edition.
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10. Agrochemicals and pesticides: A. Jadav and T.V. Sarthe
11. Name reactions in Heterocyclic Chemistry, Jie-Jack Li, Wiley Interscience publications, 2005
12. Handbook of Heterocyclic Chemistry, 2nd Edition, Alan R Karitzsky and Alexander F Pozahrskii, Elsevier Science Ltd., 2000.
13. Heterocyclic Chemistry, 5th Edition, John A. Joule and Keith Mlls, Wiley Publication, 2010.
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Section II

1. 3000 solved problems in Chemistry, David E. Goldberg, PhD., Schaums Outline
2. A guide to Quality in Analytical Chemistry: An aid to accreditation, CITAC and EURACHEM, (2002),
3. A premier sampling solids, liquids and gases, Smith Patricia I, American statistical association and the society for industrial and applied mathematics, (2001)
4. Analytical chemistry David Harvey The, McGraw Hill Companies, Inc.
5. Analytical Chemistry, Gary.D Christian, 5th edition
6. Analytical chemistry, R. K. Dave.
7. Analytical Chemistry Skoog, West ,Holler,7th Edition:
8. Analytical Chromatography, Gurdeep R Chatwal, Himalaya publication
9. Basic Concepts of Analytical Chemistry, by S M Khopkar, new Age International (p) Limited
10. Fundamentals of Analytical Chemistry by Skoog and West , 8th Edition
11. Handbook of quality assurance for the analytical chemistry laboratory, 2ndEdn., James P. Dux Van Nostr and Reinhold, 1990
12. Instrumental methods of Analysis, by DrSupriya S Mahajan, Popular Prakashan Ltd
13. Instrumental methods Of Analysis, by Willard Merritt Dean, 7thEdition, CBS Publisher and distribution Pvt Ltd
14. Instrumental Methods of Chemical Analysis by B.K. Sharma Goel Publishing House
15. Principles of Instrumental Analysis , 5th Edition, By Skoog, Holler, Nieman

16. Vogel's Textbook of Quantitative Chemical Analysis, 5thEdn., G. H. Jeffery, J Bassett, J Memdham and R C Denney, ELBS with Longmann (1989).
17. Vogel's Textbook of Quantitative Chemical analysis, Sixth edition, J.Mendham et.al.

Course Code: SIUSCHE3U5P1

Paper I

Credits: 3 Credits (8 Lectures/week)

PRACTICAL COURSE CHEMISTRY LABORATORY:

Course Code: SIUSCHE3U5P1

LEARNING OBJECTIVES

1. To establish a correlation between the theory and practical, so that the student can apply their theoretical knowledge and correlate it with hands on experience.
2. To learn the importance of various instrumentation methods in quantitative analysis.
3. To know the importance of various parameters during preparation of transition metal complexes.
4. To learn the importance of reagents in binary separation of organic mixture.
5. To develop skills of observation, recording and analyzing data.
6. To study the solubility and precipitation criteria of various organic compounds.

Course Code: SIUSCHE3U5P1 (Paper – I) 8L/Week	
P1.1	**Physical Chemistry** 1. Chemical Kinetics: To determine the order between $K_2S_2O_8$ and KI by fractional change method. 2. Potentiometry: To determine the solubility product and solubility of AgCl potentiometrically using chemical cell. 3. pH-metry: To determine acidic and basic dissociation constants of amino acid and hence to calculate isoelectric point. **Analytical Chemistry** 1. Estimation of magnesium content in talcum powder by complexometry, using standardized solution of EDTA. 2. Determination of COD of water sample. 3. To determine potassium content of a fertilizer by Flame Photometry (Calibration curve method).
P1.2	**Inorganic Chemistry** Inorganic preparations:

	1. Preparation of Potassium diaquo bis-(oxalate) cuprate (II) Determination of percentage purity: Determination of percentage purity of the given water soluble salt and qualitative detection w.r.t. added cation and/or anion (qualitative analysis only by wet tests). (Any two salts of transition metal ion). **Organic Chemistry** 1. Separation of Binary solid-solid mixture (2.0 g mixture given). Minimum Six mixtures to be completed by the students. 2. Components of the mixture should include water soluble and water insoluble acids (carboxylic acid), water insoluble phenols (2-naphthol, 1-naphthol), water insoluble bases (nitroanilines), water soluble (urea, thiourea) and water insoluble neutral compounds (anilides, amides, m-DNB, hydrocarbons) 3. A sample of the binary mixture to be given (< 1.0 g) to the student for detection of the chemical type of the mixture. After correct determination of chemical type, the fixing reagent should be decided by the student for separation. 4. Follow separation scheme with the bulk sample of binary mixture. 5. After separation into component A and component B. Drying, weighing and melting point have to be determined (No identification).

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T.Y.B.Sc. Chemistry Syllabus
SEMESTER VI

Course Code	Unit	Topics	Credits	L/Week
SIUSCHE3U61	1	**Electrochemistry**	2.5	1
		1.1 Electrochemistry (15 L)		
	2	**Polymers**		1
		2.1 Polymers (15 L)		
	3	**Theories of metal-ligand bond (I)**		1
		3.1Application of CFT to Coordination Compounds (15L)		
	4	**Organometallic Chemistry (15L)**		1
		4.1 Organometallic Compounds of main group metals (6L)		
		4.2 Metallocenes (5L)		
		4.3 Catalysis (4L)		
SIUSCHE3U62	1	**Stereochemistry, Amino acids and Proteins**	2.5	1
		1.1 Stereochemistry II (10 L)		
		1.2 Amino acids & Proteins (5 L)		
	2	**Molecular Rearrangement and Carbohydrates**		1
		2.1 Molecular Rearrangement (5 L)		
		2.2 Carbohydrates (10 L)		
	3	**Electro Analytical Techniques**		1
		1.1 Polarography (11 L)		
		1.2 Amperometric titrations (4L)		
	4	**Food And Cosmetics Analysis**		1
		2.1 Introduction to food chemistry (10L)		
		2.2 Cosmetics (5L)		
SIUSCHE3U6P1	1	**Physical and Analytical Chemistry Practical**	3	8
	2	**Inorganic and Organic Chemistry Practical**		

Course Code: SIUSCHE3U61

Paper I

Credits: 2.5 Credits (60 Lectures)

Section I		
Unit – 1, 1L/Week		**15L**
Course Code: SIUSCHE3U61.1 **LEARNING OBJECTIVES** 1. *To study the different types of cells used in electrochemistry and their applications.* 2. *To have a broad idea about of EMF series and its detailed applications in day to day activities.* 3. *To have a proper knowledge of the applications of pH, ion selective electrodes in diverse field of analysis.* 4. *To study the various applications of electrochemistry.*		
Note : Numericals and word Problems are Expected from All Units		
1 Electrochemistry		**15 L**
1.1	**Electrochemistry** **1.1.1 Activity and Activity Coefficient:** Lewis concept, ionic strength, Mean ionic activity and mean ionic activity coefficient of an electrolyte, expression for activities of electrolytes. Debye-Huckel limiting law (No derivation). **1.1.2 Classification of cells:** Chemical cells and Concentration cells. Chemical cells with and without transference, Electrode Concentration cells, Electrolyte concentration cells with and without transference. (derivations are expected)	**7 L**
1.2	**Applied electrochemistry** **1.2.1 Polarization**: concentration polarization and it's elimination. **1.2.2 Decomposition Potential and Overvoltage**: Introduction, experimental determination of decomposition potential, facto rs affecting decomposition potential. Tafel's equation for hydrogen overvoltage, experimental determination of over-voltage.	**8L**
Unit – 2, 1L/Week		**15L**
Course Code: SIUSCHE3U61.2 **LEARNING OBJECTIVES** 1. *To study the classification of polymers, determination of molar mass, lighting polymers, antioxidants and stabilizers.*		

2 Polymers		**15 L**
2.1	**Polymers** 2.1.1 Basic terms: macromolecule, monomer, repeat unit, degree of polymerization. 2.1.2 Classification of polymers: Classification based on source, structure, thermal response and physical properties. 2.1.3 Molar masses of polymers: Number average, Weight average, Viscosity average molar mass, Monodispersity and Polydispersity. 2.1.4 Method of determining molar masses of polymers: Viscosity method using Ostwald Viscometer. (derivation expected). 2.1.5 Light Emitting Polymers : Introduction, Characteristics, Method of preparation and applications. 2.1.6 Antioxidants and Stabilizers : Antioxidants, Ultraviolet stabilizers, Colourants, Antistatic agents and Curing agents.	**15 L**
Section II		
Unit – 3, 1L/Week		**15 L**
Course Code: SIUSCHE3U61.3 **LEARNING OBJECTIVES** 1. *To study the theories of metal ligand bond by applying Crystal field theory.* 2. *To learn about the crystal field splitting in octahedral, tetrahedral and square planar complexes, distortion, ligand field strength and calculate CFSE.*		
3 Theories of Metal Ligand bond (I)		**15 L**
3.1	**Application of crystal field theory to coordination compounds** 3.1.1 Limitations of Valance Bond theory. 3.1.2 Crystal field theory and effect of crystal field on central metal valence orbitals in various geometries from linear to octahedral (from coordination number 2 to coordination number 6). 3.1.3 Splitting of *d* orbitals in octahedral, tetrahedral and square planar crystal fields. 3.1.4 Distortion from the octahedral geometry: (i) effect of ligand field and (ii) Jahn-Teller distortions 3.1.5 Crystal field splitting parameter (10Dq /Δ_o) its calculation and factors affecting it in octahedral complexes, Spectrochemical series. 3.1.6 Crystal field stabilization energy (CFSE), calculation of CFSE, for octahedral complexes with d^0 to d^{10} metal ion configurations.	**15 L**

	3.1.7 Consequences of crystal field splitting on various properties such as ionic radii, hydration energy, lattice energy, enthalpies of formation of the first transition series. 3.1.8 Limitations of CFT: Evidences for covalence in metal complexes: (i) Intensities of d-d transitions, (ii) ESR spectrum of $[IrCl_6]^{2-}$ and (iii) Nephelauxetic effect.	
Unit – 4, 1L/Week		**15 L**
Course Code: SIUSCHE3U62.4 **LEARNING OBJECTIVES** *1. To know the orientation of organic molecules to bond with metal to form ligands.* *2. To understand the various synthetic methods and chemical reactions of organometallic compounds.* *3. To study the structure and bonding nature of metallocenes on the basis of VBT.* *4. To introduce various catalytic reaction of organometallic compounds.*		
4 Organometallic compounds		**15 L**
4.1	**Organometallic Compounds of main group metals** 4.1.1 General characteristics of various types of organometallic compounds, viz., ionic, σ-bonded and electron deficient compounds. 4.1.2 General synthetic methods: (i) Oxidative addition, (ii) Metal-Metal exchange (Transmetallation) Carbanion-Halide exchange, (iv) Metal Hydrogen exchange and (v) Methylene insertion reactions. 4.1.3 Some Chemical reactions of organometallic compounds (i) Reactions with oxygen and halogens, (ii) Alkylation and arylation reactions (iii) Reactions with protic reagents and (iv) Complex formation reactions.	**6L**
4.2	**Metallocenes** 4.2.1 Introduction, Ferrocene: Synthesis, properties, structure and bonding on the basis of VBT.	**5L**
4.3	**Catalysis (4L)** 4.3.1 Comparison of homogeneous and heterogeneous catalysis 4.3.2 Basic steps involved in homogeneous catalysis. 4.3.3 Mechanism of Ziegler-Natta in polymerization of alkenes and Mechanism of Wilkinson's catalyst in hydrogenation of alkene.	**4L**

Course Code: SIUSCHE3U63

Paper II

Credits: 2.5 Credits (60 Lectures)

Section I		
Unit – 1, 1L/Week		**15L**
Course Code: SIUSCHE3U62.1 **LEARNING OBJECTIVES** *1. To study the concept selectivity and topicity.* *2. To study the stereochemical aspects of various organic reactions* *3. To learn the basic chemical and structural features of amino acids and proteins.*		
1 Stereochemistry, Amino acids & Proteins		**15L**
1.1	**Stereochemistry II** 1.1.1 Stereoselectivity and stereospecificity: Idea of enantioselectivity (ee) and diastereoselectivity (de), Topicity: enantiotopic and diasterotopic atoms, groups and faces. 1.1.2 Stereochemistry of – i) Substitution reactions :S_Ni (reaction of alcohol with thionyl chloride) ii) Elimination reactions: E_2–Base induced dehydrohalogenation of 1-bromo-1,2-diphenylpropane. iii) Addition reactions to olefins: a) bromination (electrophilic anti addition) b) syn hydroxylation with O_sO_4 and $KMnO_4$ c) epoxidation followed by hydrolysis.	**10 L**
1.2	**Amino acids & Proteins** **1.2.1** α-Amino acids: General structure, configuration and classification based on structure and nutrition. Properties: pH dependency of ionic structure, isoelectric point and zwitter ion. Methods of preparations: Strecker synthesis, Gabriel Phthalamide synthesis. **1.2.2** Polypeptides and Proteins: nature of peptide bond. Nomenclature and representation of polypeptides (di-and tri-peptides) with examples. Merrifield solid phase polypeptide synthesis, proteins: general idea of primary, secondary, tertiary & quaternary structure.	**5L**
Unit – 2, 1L/Week		**15L**
Course Code: SIUSCHE3U62.2		

LEARNING OBJECTIVES 1. *To learn various molecular rearrangement reaction.* 2. *To learn the basic chemical and structural features and importance of carbohydrate.* 3. *To write the various functional group transformation in carbohydrates.*		
2 Molecular Rearrangement & Carbohydrates		**15 L**
2.1	**Molecular Rearrangement** Mechanism of the following rearrangements with examples and stereochemistry wherever applicable. 2.1.1 Migration to the electron deficient carbon: Pinacol-pinacolone rearrangement. 2.1.2 Migration to the electron deficient nitrogen: Beckmann rearrangement. 2.1.3 Migration involving a carbanion: Favorski rearrangement. 2.1.4 Name reactions: Michael addition, Wittig reaction.	**5 L**
2.2	**Carbohydrates** 2.2.1 Introduction: classification, reducing and non-reducing sugars, DL notation 2.2.2 Structures of monosaccharides: Fischer projection (4-6 carbon monosaccharides) and Haworth formula (furanose and pyranose forms of pentoses and hexoses) Interconversion: open chain and Haworth forms of monosaccharides with 5 and 6 carbons.Chair conformation with stereochemistry of D-glucose, Stability of chair form of D-glucose 2.2.3 Stereoisomers of D-glucose: enantiomer, diastereomers, anomers, epimers. 2.2.4 Mutarotation in D-glucose with mechanism 2.2.5 Chain lengthening & shortening reactions: Modified Kiliani-Fischer synthesis (D-arabinose to D-glucose and D-mannose), Wohlmethod (D-glucose to D-arabinose) 2.2.6 Reactions of D-glucose and D-fructose: (a)Osazone formation (b) reduction: Hi/Ni, $NaBH_4$ (c) oxidation: bromine water, HNO_3, HIO_4 (d) acetylation (e) methylation:(d) and (e) with cyclic pyranose forms 2.2.7 Glycosides: general structure.	**10 L**
Section II		
Unit – 3, 1L/Week		**15 L**
Course Code: SIUSCHE3U62.3 **LEARNING OBJECTIVES** 1. *To study the various electroanalytical techniques and its applications.* 2. *To make the learner capable of solving problems.*		

3 Electro Analytical Techniques		
3.1	**Polarography (Numerical and word problems are expected)** 3.1.1 Difference between potentiometry and voltammetry, Polarizable and non-polarizable electrodes 3.1.2 Basic principle of polarography H shaped polarographic cell, DME (construction, working, advantages and limitations) 3.1.3 DC polarogram: Terms involved - Residual current, Diffusion current, Limiting current, Half-Wave Potential Role and selection of supporting electrolyte, Interference of oxygen and its removal, polarographic Maxima and Maxima Suppressors Qualitative aspects of Polarography: Half wave potential $E_{1/2}$, Factors affecting $E_{1/2}$ Quantitative aspects of polarography: Ilkovic equations*: various terms involved in it (No derivation) 3.1.4 Quantification 1) Wave height – Concentration plots (working plots/calibration) 2) Internal standard (pilot ion) method 3) Standard addition method 3.1.5 Applications, advantages and limitations	**11 L**
3.2	**Amperometric Titrations** 3.2.1 Principle, Rotating Platinum Electrode(Construction, advantages and limitations) 3.2.2 Titration curves with example 3.2.3 Advantages and limitations	**4 L**
Unit – 4, 1L/Week		**15 L**
Course Code: SIUSCHE3U62.4 **LEARNING OBJECTIVES** 1. *To introduce the learner with food and cosmetics through analytical chemistry view.* 2. *To study the analysis of various essential ingredients of food and cosmetics.*		
4 Food and Cosmetics Analysis		

4.1	**Introduction to food chemistry** 4.1.1 Food processing and preservation: Introduction, need, chemical methods, action of chemicals(sulphur dioxide, boric acid, sodium benzoate, acetic acid, sodium chloride and sugar) and pH control. Physical methods (Pasteurization and Irradiation) 4.1.2 Determination of boric acid by titrimetry and sodium benzoate by HPLC. 4.1.3 Study and analysis of food products and detection of adulterants 1) Milk: Composition & nutrients, types of milk (fat free, organic and lactose milk) Analysis of milk for lactose by Lane Eynon's Method 2) Honey: Composition Analysis of reducing sugars in honey by Coles Ferricyanide method 3) Tea: Composition, types (green tea and mixed tea) Analysis of Tannin by Lowenthal's method 4) Coffee: Constituents and composition, Role of Chicory Analysis of caffeine by Bailey Andrew method	**10L**
4.2	**Cosmetics** 4.2.1 Introduction and sensory properties 4.2.2 Study of cosmetic products – 1) Face powder: Composition, Estimation of calcium and magnesium by complexometric titration 2) Lipstick: Constituents, Ash analysis for water soluble salts: borates, carbonates and zinc oxide. 3) Deodorants and Antiperspirants: Constituents, properties, Estimation of Zinc by gravimetry.	**5L**

Note: Concept of sensitivity is to be discussed for all techniques and instruments mentioned in the syllabus.

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1. Geoffrey A. Lawrance Introduction to Coordination Chemistry John Wiley & Sons.
2. R. K. Sharma Text Book of Coordination Chemistry Discovery Publishing House
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5. Glen E. Rodgers, Descriptive Inorganic, Coordination, and Solid-State Chemistry Publisher: Thomson Brooks/Cole
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15. Ram Charan Mehrotra, Organometallic Chemistry: A Unified Approach, New Age International.
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1. An Advance Dairy chemistry, V 3, P. F. Fox, P. L. H. McSweeney Springer
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24. Vogel's Textbook of Quantitative Chemical Analysis, 5thEdn., G. H. Jeffery, J Bassett, J Memdham and R C Denney, ELBS with Longmann (1989).
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Course Code: SIUSCHE3U6P1

Paper I

Credits: 3 Credits (8 Lectures/ week)

PRACTICAL COURSE CHEMISTRY LABORATORY:

Course Code: SIUSCHE3U6P1

LEARNING OBJECTIVES

1. To learn the importance of various instrumentation methods in quantitative analysis.

2. To know the importance of various parameters during preparation of metal complexes.

3. To learn the synthesis of organic compound and determinate the purification of the product.

Course Code: SIUSCHE3U6P1 (Paper – I) 8L/Week	
P1.1	**Physical Chemistry** 1. Viscosity: To determine the molecular weight of high polymer polyvinyl alcohol (PVA) by viscosity measurement. 2. Potentiometry: To determine the number of electrons in the redox reaction between ferrous ammonium sulphate and cerric ammonium sulphate potentiometrically. 3. Colorimetry: To estimate the amount of Fe (III) in the complex formation with salicylic acid by Static Method. **Analytical Chemistry** 1. Estimation of Chromium in water sample spectrophotometrically by using Diphenyl carbazide. 2. Separation and estimation of Mg(II) and Zn(II) from given sample solution using an anion exchange resin. 3. Estimation of acetic acid in Vinegar sample by using Quinhydrone electrode potentiometrically.
P1.2	**Inorganic Chemistry** <u>Inorganic preparations</u> 1. Preparation of tris(acetylacetonato)iron(III) <u>Determination of percentage purity of the given water soluble salt and qualitative detection w.r.t. added cation and/or anion</u> **(qualitative analysis only by wet tests).** (Any two salts of main group metal ions). **Organic Chemistry** <u>Preparations: Drying, weighing & melting point (No Purification)</u> 1. Aniline / p-toluidine → N-Acetyl derivative 2. Salicylic acid / nitrobenzene / Acetanilide → Nitro derivative

	3. Hydrolysis of p-nitroacetanilide 4. Methyl salicylate / ethyl benzoate → Acid derivative (Hydrolysis)

SUGGESTED REFERENCE SIUSCHE3U6P1

1. Practical organic chemistry – A. I. Vogel
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16. Chemical Analysis in the laboratory –A Basic guide by Irene Muller-Harvey, Richard M. Baker, Royal Society of Chemistry
17. Textbook of Quantitative Inorganic Analysis -Vogel A.I. 5th Edition

MODALITY OF ASSESSMENT

THEORY EXAMINATION PATTERN:

(A) Semester End Theory Internal Assessment - 40 Marks

Internal Assessment	Marks
Class test	**20**
Assignment / Case Study / Project / Presentation/ etc.)	**15**
Active participation and overall conduct in class	**05**
Total Marks	**40**

(B) Semester End Theory Assessment - 60 Marks (Duration - These examinations shall be of **2 hours** duration).

Theory question paper pattern:

1. There shall be **four** questions.
2. Each unit there will be one question with **15** Marks each.
3. All questions shall be **compulsory** with internal choices within the questions.

   Question 1 (Unit-1),

   Question 2 (Unit-2),

   Question 3 (Unit-3) &

   Question 4 (Unit-4).
4. All Questions may be sub divided into sub questions of **five** marks each.
5. Please ensure that the allocation of marks depends on the number of lectures allotted for each topic.

Marks distribution pattern for theory examination

Theory Examination	Paper I	Paper II	Grand Total
Theory Internal Assessment	**40**	**40**	**80**
Theory	**60**	**60**	**120**
Total	**100**	**100**	**200**

II] PRACTICAL EXAMINATION PATTERN:

Scheme of examination: There will be no internal assessment for practical.

A candidate will be allowed to appear for the semester end practical examination only if the candidate submits a **certified journal** at the time of practical examination or a certificate from the Head of the Department/Institute to the effect that the candidate has completed the practical course of that semester of T.Y.B.Sc. Chemistry as per the minimum requirement.

The duration of the practical examination will be three and half hours per experiment. The questions on slips for the same should be framed in such a way that candidate will be able to complete the task and should be evaluated for its skill and understanding of chemistry.

Note: Minimum 75% experiments of prescribed syllabus should be completed in the 5th and 6th semester. Certified journal is a must to be eligible to appear for the semester end practical examination, failing which they will not be allowed to appear for the examination.

Marks distribution pattern for practical examination

Sr. No.	Practical Examination	Marks		Total
		Paper-I		
		P1.1	P1.2	
1.	Experimental work	40	40	80
2.	Journal	05	05	10
3.	Viva – Voce	05	05	10
Total		50	50	100

Overall Examination and Marks Distribution Pattern

Semester End Examination	Paper I	Paper II	Grand Total
Theory Internal Assessment	40	40	80
Theory	60	60	120
Practical	50	50	100
Total	150	150	300