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

BOTANY (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 Botany

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

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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.
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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.*
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SIES

College of Arts, Science & Commerce

RISE WITH EDUCATION

Sion (W), Mumbai - 400022

Program: B.Sc.

Course: BOTANY

Syllabus for T.Y.B.Sc. (3 Units)

To be implemented from 2019-20

Credit Based Semester and Grading System with effect from the academic year 2019-20

PREAMBLE

In the revised autonomous syllabus, the committee has taken utmost care to maintain the continuity in the flow of information at T.Y.B.Sc. level. Hence, some of the modules of the existing university syllabus have been upgraded with the new modules in order to introduce the learners to the recent developments in various branches of Botany.

Paper II and III of theory and practicals (Semester - V & Semester - VI together) are compulsory for the TYBSc students of 3 Units according to their specialization.

Each theory period shall be of 48 minutes duration. Theory component shall have 120 instructional periods per semester. Each practical will be of 4 periods of 48 minutes each.

MODALITY OF ASSESSMENT:

Theory Examination Pattern

A) Internal Assessment – 40M

(20M Class Test + 15M Assignment/Case study/ ppt. + 05 Class participation)

B) External examination – 60M (Semester End Theory Assessment)

i. Duration - These examinations shall be of two and half hours duration.

ii. Theory question paper pattern: attached herewith.

Practical Examination Pattern:

A. Internal Examination: There will not be any internal examination/ evaluation for practicals.

B. External (Semester end practical examination)

The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination. In case of loss of Journal and/ or Report, a Lost Certificate should be obtained from Head of the Department/ Co-ordinator of the department; failing which the student will not be allowed to appear for the practical examination.

Overall Examination and Marks Distribution Pattern for Semester V

Course	PAPER II			PAPER III			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	**200**
Practicals	-	50	50	-	50	50	**100**

Overall Examination and Marks Distribution Pattern for Semester VI

Course	PAPER II			PAPER III			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	**200**
Practicals	-	50	50	-	50	50	**100**

T.Y.B.Sc. Botany Syllabus (Restructured for Credit Based and Grading System)
To be implemented from the Academic year 2019-2020

SEMESTER V

Course Code	UNIT	TOPICS	Credit	L / Weeks
SIUSBOTP52	PLANT DIVERSITY IV			
	I	Paleobotany	2.5	1
	II	Angiosperms I		1
	III	Anatomy I		1
	IV	Palynology		1
SIUSBOT53	FORM AND FUNCTION III			
	I	Cytology and Molecular biology	2.5	1
	II	Physiology I		1
	III	Environmental Botany		1
	IV	Plant tissue culture		1
SIUSBOTP5.1 (3Units)	Practicals based on all the two courses in theory		3	8

SEMESTER VI

Course Code	UNIT	TOPICS	Credit	L / Weeks
SIUSBOTP62	PLANT DIVERSITY IV			
	I	Angiosperms II	2.5	1
	II	Anatomy II		1
	III	Embryology		1
	IV	Biostatistics		1
SIUSBOT63	FORM AND FUNCTION III			
	I	Plant Biochemistry	2.5	1
	II	Physiology II		1
	III	Genetics		1
	IV	Bioinformatics		1
SIUSBOTP6.1 (3Units)	Practicals based on the two courses in theory		3	8

SEMESTER V THEORY

Course Code	Title	Credits
SIUSBOT52	**PLANT DIVERSITTY III**	**2.5 (60 lectures)**

LEARNING OBJECTIVES

The students will be able to-

- ❖ Study different fossils & contribution of Birbal Sahni in the field of Paleobotany.
- ❖ Understand the morphology of fruits & general characteristics and economic importance of angiosperms.
- ❖ Learn the different aspects of plant anatomy & palynology.

CIA – Class Test (20M) + Assignment/ Case Study/ Presentation (15M) + Class Participation (5M)

Unit I : Paleobotany • *Calamites* – All form genera Stem, leaf, male and female fructification • *Lepidodendron* – All form genera root, stem, bark, leaf, male and female fructification • *Lyginopteris* – All form genera root, stem, leaf, male and female fructification • *Pentoxylon* – All form genera • Contribution of Birbal Sahni, Birbal Sahni Institute of Paleobotany, Lucknow	**(15 lectures)**
Unit II : Angiosperms I • Morphology of fruit • Complete classification of Bentham and Hooker (only for prescribed families), Merits and demerits • Bentham and Hooker's system of classification for flowering plants up to family with respect to the following prescribed families and economic and medicinal importance for members of the families o Capparidaceae o Umbelliferae o Cucurbitaceae o Rubiaceae o Solanaceae o Commelinaceae o Graminae	**(15 lectures)**
Unit III : Anatomy • Anomalous secondary growth in the Stems of *Bignonia*, *Salvadora*, *Achyranthes*, *Aristolochia*, *Dracaena*. Storage roots of Beet, Radish • Root stem transition • Types of Stomata – Anomocytic, Anisocytic, Diacytic, Paracytic and Graminaceous	**(15 lectures)**
Unit IV : Palynology • Pollen Morphology – Structure of pollen grain, shape and size variations in pollen, pollen units, polarity, symmetry, pollen wall, excrescences, apertures, NPC classification, exine ornamentations, LO analysis, significance of pollen morphology • Germination and growth of pollen tube • Pollen viability - Concept, deficiency, tests, pollen storage • Application of Palynology in honey industry, coal and oil exploration, Aerobiology and pollen allergies, forensic science	**(15 lectures)**

Course Code	Title	Credits
SIUSBOT53	**FORM AND FUNCTIONS- II**	**2.5 (60 lects.)**

LEARNING OBJECTIVES

The students will be able to-

- ❖ Study structure of nucleus & its function also characteristics of the genetic code, transcription and translation processes.
- ❖ Understand different aspects of water relations in plants. Bioremediation & succession.
- ❖ Learn the different techniques in Plant tissue culture & its application.

CIA – Class Test (20M) + Assignment/ Case Study/ Presentation (15M) + Class Participation (5M)

Unit I : Cytology And Molecular Biology • Structure and function of nucleus • Structure and function of vacuole • Structure and function of giant chromosomes • The genetic code: Characteristics of the genetic code • Transcription and Translation in Eukaryotes	**(15 lectures)**
Unit II: Physiology • **Water relations:** Potential, osmosis, transpiration, imbibition • Solute transport: Transport of ions across cell membranes, active and passive transport, carriers, channels and pumps. • Translocation of solutes: Composition of phloem sap, girdling experiment, pressure flow model, phloem loading and unloading, anatomy of sieve tube elements, mechanisms of sieve tube translocation, Munch's hypothesis. • Mineral nutrition: Significance and deficiency symptoms of macronutrients – N, P, K, Mg, Ca; micronutrients – S, B, Zn, Fe, Mn, Mo	**(15 lectures)**
Unit III: Environmental Botany • **Bioremediation:** Principles, factors responsible and microbial population in bioremediation. • **Phytoremediation**: Metals, Organic pollutants • **Plant succession**: Hydrosere and Xerosere – Formation of barren space, succession on the land citing different seres leading up to the climax, succession in water, ecesis, poly and monoclimax theories.	**(15 lectures)**
Unit IV: Plant Tissue Culture • Applications of micropropagation in Floriculture and detailed study of Orchid culture. • Plant cell suspension cultures for the production of secondary metabolites with special reference to Shikonin production. • Somatic embryogenesis and artificial seeds- Concept, definition and various methods of protoplast fusion. • Applications of somatic hybridization in agriculture.	**(15 lectures)**

SEMESTER V PRACTICAL

PRACTICAL II – PLANT DIVERSITY IV SIUSBOTP5.1 (3 Units)	
Paleobotany Study of the following form genera with the help of permanent slides/ photomicrographs. • *Calamites* • *Lepidodendron* • *Lyginopteris* • *Pentoxylon*	
Angiosperms • Morphology of fruit • Study of one plant from each of the following Angiosperm families ▪ Capparidaceae ▪ Umbelliferae ▪ Cucurbitaceae ▪ Rubiaceae ▪ Solanaceae ▪ Commelinaceae ▪ Graminae • Morphological peculiarities and economic importance of the members of the above mentioned Angiosperm families • Identifying the genus and species of a plant with the help of Flora	
Anatomy I **Study of anomalous secondary growth in the stems using double staining technique:** • *Bignonia* • *Salvadora* • *Achyranthes* • *Aristolochia* • *Dracaena* **Study of anomalous secondary growth in the roots of** • Beet • Radish **Types of Stomata** • Anomocytic • Anisocytic • Diacytic • Paracytic • Graminaceous	
Palynology Study of pollen morphology (NPC Analysis) of the following by Chitale's Method • *Hibiscus* • *Datura* • *Ocimum* • *Crinum* • *Pancratium* • *Canna* Determination of pollen viability Pollen analysis from honey sample – unifloral and multifloral honey Effect of varying concentration of sucrose on *In vitro* Pollen germination	

PRACTICAL III - FORM AND FUNCTION II SIUSBOTP5.1 (3 Units)	
Cytology And Molecular Biology • Mounting of Giant chromosomes from Chironomous larva • Smear preparation from *Tradescantia* buds • Predicting the sequence of amino acids in the polypeptide chain that will be formed following translation (Eukaryotic)	
Physiology • Estimation of Phosphate phosphorus (Plant acid extract) • Estimation of Iron (Plant acid extract)	
Environmental Botany Estimation of the following in given water sample • Dissolved oxygen demand • Biological oxygen demand • Hardness • Salinity and Chlorinity	
Micropropogation Plant Tissue culture: • Identification – Multiple shoot culture, hairy root culture, somatic embryogenesis • Preparation of stock solutions for preparation of MS medium (Note: Concept of preparation of specified molar solutions should be taught and problems based on preparation of stock solutions for tissue culture media will be given).	

SEMESTER VI

Course Code	Title	Credits
SIUSBOT62	**PLANT DIVERSITTY IV**	**2.5 (60 lects)**

LEARNING OBJECTIVES

The students will be able to-

- ❖ Understand the general characteristics and economic importance of angiosperms & Major Botanic gardens of India.
- ❖ Learn the different aspects of ecological anatomy & embryology.
- ❖ Study different statistical tests & their applications.

CIA – Class Test (20M) + Assignment/ Case Study/ Presentation (15M) + Class Participation (5M)

Unit I : Angiosperms II • Major Botanical gardens of India – Indian Botanical Garden, Howrah; National Botanical Garden (NBRI) Lucknow; Lloyd Botanical Garden, Darjeeling; Lalbaugh or Mysore State Botanical Garden Bangalore • Botanical survey of India and regional branches of India • Study of following plant families ➢ Combretaceae ➢ Rhamnaceae ➢ Asclepiadaceae ➢ Labiatae ➢ Euphorbiaceae ➢ Cannaceae • Hutchinson's classification – merits and demerits	**(15 lectures)**
Unit II : Anatomy II Ecological adaptations and anatomy of: • Hydrophytes – submerged, floating, rooted • Hygrophytes - *Typha* • Mesophytes • Sciophytes • Halophytes • Epiphytes • Xerophytes	**(15 lectures)**
Unit III : Embryology • Microsporogenesis • Megasporogenesis - Development of monosporic type, examples of all embryo sacs • Types of ovules • Double fertilization • Development of embryo – *Capsella*	**(15 lectures)**
Unit IV : Biostatistics • Test of significance student's *t*-test (paired and unpaired) • Regression • ANOVA (one way)	**(15 lectures)**

Course Code	Title	Credits
SIUSBOT63	**FORM AND FUNCTION III**	**2.5 (60 lectures)**

LEARNING OBJECTIVES

The students will be able to -

- ❖ Understand biomolecules and Enzyme kinetics, nitrogen metabolism & PGRs.
- ❖ Study Genetic mapping in eukaryotes, Gene mutations & metabolic disorders.
- ❖ Learn the Organization, retrieval, analysis and application biological data.

CIA – Class Test (20M) + Assignment/ Case Study/ Presentation (15M) + Class Participation (5M)

Unit I: Plant Biochemistry • Structure of biomolecules: Carbohydrates (sugars, starch, cellulose, pectin, lipids (fatty acids and glycerol), proteins (amino acids) • Enzymes: Nomenclature, classification, mode of action, Enzyme kinetics, Michaelis Menten equation, competitive non-competitive, and uncompetitive inhibitors.	**15 Lectures**
Unit II: Plant Physiology II • Nitrogen metabolism: Nitrogen cycle, root nodule formation, and leg haemoglobin, nitrogenase activity, assimilation of nitrates, (NR, NiR activity), assimilation of ammonia, (amination and transamination reactions), nitrogen assimilation and carbohydrate utilisation. • Physiological effects and commercial applications of Auxins, Gibberillins, Cytokinins, Ethylene and Abscissic acid.	**15 Lectures**
Unit III: Genetics • Linkage & crossing over, Gene recombination, Genetic mapping in eukaryotes, Construction of genetic maps, three point crosses and mapping chromosomes, problems based on the same. • Gene mutations: definition, types of mutations, causes of mutations, induced mutations, the Ame's test • Metabolic disorders – enzymatic and non-enzymatic: Gene control of enzyme structure Garrod's hypothesis of inborn errors of metabolism, Phenylketonuria, albinism, sickle cell anaemia.	**15 Lectures**
Unit IV: Bioinformatics • Organization of biological data, databases • Exploration of data bases, retrieval of desired data, BLAST. • Protein structure analysis and application • Multiple sequence analysis and phylogenetic analysis	**15 Lectures**

SEMESTER VI PRACTICAL

PRACTICAL II – PLANT DIVERSITY IV SIUSBOTP6.1 (3 Units)	**Cr. 1.5**
Angiosperms • Study of one plant from each of the following Angiosperm families ▪ Combretaceae ▪ Rhamnaceae ▪ Asclepiadaceae ▪ Labiatae ▪ Euphorbiaceae ▪ Cannaceae • Morphological peculiarities and economic importance of the members of the above mentioned Angiosperm families • Identify the genus and species with the help of flora	
Anatomy Study of Ecological Anatomy of • Hydrophytes: *Hydrilla* stem, *Nymphaea* petiole, *Eichhornia* offset • Epiphytes: Orchid • Sciophytes: *Peperomia* leaf • Xerophytes: *Nerium* leaf, *Opuntia* phylloclade • Halophytes: *Avicennia* leaf and pneumatophore, *Sesuvium* / *Sueda* leaf • Mesophytes: *Vinca* leaf	
Embryology • Study of various stages of Microsporogenesis, Megasporogenesis and Embryo Development with the help of permanent slides / photomicrographs • Mounting of Monocot (Maize) and Dicot (Castor and Gram) embryo • *In vivo* growth of pollen tube in *Portulaca/Vinca*	
Biostatistics • *t*-test (paired and unpaired) • Problems based on regression analysis • ANOVA	
PRACTICAL III – Form and function III SIUSBOTP6.1 (3 Units)	**Cr. 1.5**
Plant Biochemistry • Estimation of proteins by Biuret method • Effect of temperature on the activity of amylase • Effect of pH on the activity of amylase • Effect of substrate variation on the activity of amylase	
Plant Physiology • Determination of alpha-amino nitrogen • Effect of GA on seed germination • Estimation of reducing sugars by DNSA method	
Genetics • Problems based on three point crosses, construction of chromosome maps • Identification of types of mutations from given DNA sequences • Study of mitosis using pre-treated root tips of *Allium*	
Bioinformatics • BLAST: nBLAST, pBLAST • Multiple sequence alignment • Phylogenetic analysis • RASMOL/ SPDBV	

Note:

1. A minimum of four field excursions (with at least one beyond the limits of Mumbai) for habitat studies are compulsory. Field work of not less than eight hours duration is equivalent to one period per week for a batch of fifteen students.

2. A candidate will be allowed to appear for the practical examinations only if he/she submits a certified journal of TYBSc Botany and the Field Report or a certificate from the Head of the Department/Institute to the effect that the candidate has completed the practical course of TYBSc Botany as per the minimum requirements. In case of loss of journal a candidate must produce a certificate from the Head of the Department/ Institute that the practical for the academic year were completed by the student. However such a candidate will be allowed to appear for the practical examination but the marks allotted for the journal will not be granted.

SIES COLLEGE OF ARTS, SCIENCE&COMMERCE

Sion (W), Mumbai-400 022

Fifth/Sixth Semester

Class: T.Y.B.Sc (3 Units) **Sub: Botany** **Paper: II/III**

Day: **Date:** **Time:** **Marks: 60**

N.B.: **1) All questions are Compulsory.**

2) Figures to the right indicate marks.

3) Draw neat labelled diagrams wherever necessary.

Q.1 **a)** Unit I: Long answer question **(10)**

OR

a) Unit I: Long answer question **(10)**

b) Write note on **any one** of the following: **(05)**

i Unit I

ii Unit I

Q.2 **a)** Unit II: Long answer question **(10)**

OR

a) Unit II: Long answer question **(10)**

b) Write note on **any one** of the following: **(05)**

i Unit II

ii Unit II

Q.3 **a)** Unit III: Long answer question **(10)**

OR

a) Unit III: Long answer question **(10)**

b) Write note on **any one** of the following: **(05)**

i Unit III

ii Unit III

Q.4 **a)** Unit IV: Long answer question **(10)**

OR

a) Unit IV: Long answer question **(10)**

b) Write note on **any one** of the following: **(05)**

i Unit IV

ii Unit IV

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SIES COLLEGE OF ARTS, SCIENCE & COMMERCE
T.Y.B.Sc. BOTANY SEMESTER V
PLANT DIVERSITY IV
PRACTICAL II

Duration: 3 hours **Max. Marks : 50**

Q.1A	Classify specimen **A** up to its family giving reasons. Give floral formula. Sketch and labelled L.S. of flower and T.S. ovary.	**10M**
Q.1B	Identify genus and species of specimen **B** using flora.	**05M**
Q.2	Make a temporary double stained preparation of T.S. specimen '**C**' and comment on the type of secondary growth.	**08M**
Q.3	Perform the Palynology experiment **D** allotted to you.	**07M**
Q.4	Identify and describe slide/ specimen **E, F, G** and **H**.	**12M**
Q.5	Field report	**05M**
Q.6	Viva voce (based on Paper I and Paper II).	**03M**
	Key: A – Familiies of T.Y.B.Sc only B – Plants from F.Y & S.Y. B. Sc Families to be included C- Anatomy- Anomalous Secondary Growth D- As per slip E, F, G & H Fossils, Types of Stomata, Morphology of Fruits – in random order	

SIES COLLEGE OF ARTS, SCIENCE & COMMERCE
T.Y.B.Sc. BOTANY SEMESTER V
FORMS AND FUNCTIONS III
PRACTICAL III

Duration: 3 hours **Max. Marks : 50**

Q.1	Make a smear preparation of material **A** and show the slide to the Examiner. Comment on your observation/ Expose the giant Chromosomes from the salivary glands of Chironomous larva.	**08M**
Q.2	Perform the experiment **B** allotted to you (Physiology).	**12M**
Q.3	Perform the experiment **C** allotted to you (Ecology).	**12M**
Q.4	Calculate the _____ of the given solution **D** to prepare the required solution	**07M**
Q.5	Identify and describe slide/specimen **E** & **F.**	**06M**
Q.6	Journal	**05M**
	Key: B: Physiology experiment C: Ecology experiment D: Plant tissue culture E & F: Multiple shoot culture, hairy root culture, somatic embryogenesis, amino acid sequencing.	

SIES COLLEGE OF ARTS, SCIENCE & COMMERCE
T.Y.B.Sc. BOTANY SEMESTER VI
PLANT DIVERSITY IV
PRACTICAL II

Duration: 3 hours **Max. Marks : 50**

Q.1	From the given data/ material **A** determine test of significance using students t-test/ Regression Analysis/ ANOVA	**10M**
Q.2A	Classify specimen **B** up to its family giving reasons. Give floral formula. Sketch and labelled L.S. of flower and T.S. ovary.	**10M**
Q.2B	Identify genus and species of specimen **C** using flora.	**05M**
Q.3	Make a stained preparation of specimen **D** and comment on its ecological anatomy.	**08M**
Q.4	Identify and describe slide/specimen **E, F, G** and **H**.	**12M**
Q.5	Viva voce (based on Paper III and paper IV)	**05M**
	Key - • **A** - Problem on Biostatistics • **B** - Families of T.Y.B.Sc only • **C** - Plants from F.Y., S.Y. & T.Y.B.Sc. SEM V Families to be included • **D** - Ecological anatomy • **E, F, G & H** [In random order], Economic importance of specimen from prescribe families (Sem VI only) & Embryology	

SIES COLLEGE OF ARTS, SCIENCE & COMMERCE
T.Y.B.Sc. BOTANY SEMESTER VI
FORMS AND FUNCTIONS III
PRACTICAL III

Duration: 3 hours **Max. Marks : 50**

Q.1	Perform the experiment **A** allotted to you.	**10M**
Q.2	Perform the experiment **B** allotted to you.	**10M**
Q.3	Make a squash preparation to show the stage of mitosis from pre-treated root tips **C**.	**06M**
Q.4	Construct a chromosome map from the given data **D**/ Identify the type of mutation and comment on them (any two types of mutations).	**12M**
Q.5	Perform the given analysis of data **E** using computer (Bioinformatics).	**07M**
Q.6	Journal.	**05M**
	Key - • A: Plant Biochemistry Experiment • B: Plant Physiology Experiment	

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