JAI HIND COLLEGE
BASANTSING INSTITUTE OF SCIENCE
&
J.T.LALVANI COLLEGE OF COMMERCE
(AUTONOMOUS)

"A" Road, Churchgate, Mumbai - 400 020, India.

Affiliated to
University of Mumbai

FYBSC Semester 2

Biotechnology

Credit Based Semester and Grading System (CBCS)

With effect from the academic year 2019-20

SEMESTER 2

SBT201	**Cell Biology and Plant Physiology**	**2 Credits**
Learning Objectives	➢ **To provide an understanding of the ultrastructure of both prokaryotic and eukaryotic cells** ➢ **To acquaint students with Physiological Processes in Plants**	
Course description	**At the end of this course, the student will be able to differentiate between prokaryotes and eukaryotes. The student will also have an understanding of the different physiological processes in the eukaryotic living system viz. plants.**	
	THEORY	**(45 lectures)**
Sub Unit	**Unit – I: Ultrastructure of Prokaryotic Cells**	**15 lectures**
1.	**a) Ultrastructure of Prokaryotic cell** (Detailed structure, chemical nature, significance and application) i) Concept of cell shape and size ii) Glycocalyx: slime layer, capsule, iii) Flagella, pilli iv) Cell wall- Gram positive and gram negative (reference to archaebacteria) v) Cell membrane, mycolic acids, cytoplasm, genetic material, and plasmids vi) Storage bodies, pigments and spores	
	b) Unit – II: Ultrastructure of Eukaryotic cell	**15 lectures**
	a) Ultrastructure of Eukaryotic cell (Detailed structure, chemical nature, significance and application) i) Cell wall ii) Plasma membrane iii) Cytoplasmic matrix iv) Microfilaments, Intermediate filaments and microtubules v) Organelles of the Biosynthetic and secretory pathways - Endoplasmic reticulum & Golgi apparatus vi) Lysosome - Endocytosis, Phagocytosis, Autophagy, Proteasome vii) Eukaryotic ribosomes viii) Mitochondria and plastids ix) Nucleus- Nuclear structure, Nucleolus x) External cell coverings - Cilia and Flagella xi) Gums and resins **b) Comparison of Prokaryotic and Eukaryotic cell**	

	Unit – III: Photosynthetic systems	15 lectures
1.	**Photosynthesis** i) Intracellular Organization of Photosynthetic System ii) Fundamental Reactions of Photosynthesis, Photosynthetic Pigments, Role of Light. iii) Hill Reaction and its Significance, Light Reactions, iv) The central Photochemical event; Cyclic and Non-Cyclic Photo induced Electron Flow, v) Role of Cytochrome b_6f vi) ATP synthesis by Photophosphorylation vii) Use of Hydrogen donors by diverse Photosynthetic organisms	
CA **(Continuous Assessment)**	CA1- Written test CA 2- Presentations	
References:	• De Robertis E. D. P. (2001). Cell and Molecular Biology. 8th Edition. Lippincott Williams and Wilkins. • Karp G. (2008). Cell and Molecular Biology- Concepts and Experiments. 5th Edition. John Wiley and Sons Inc. • Powar C. B. (1983). Cell Biology. 3rd Edition. Himalaya Publishing House Pvt. Ltd. • Nelson D. L., and Cox M. M. (2008). Lehninger Principles of Biochemistry. 5th Edition. W H Freeman and Company • Devlin R.M. (1983). Fundamentals of Plant Physiology. Macmillan, New York. • Dutta A.C. (2000). A Classbook of Botany. Oxford University Press, UK. • Gangulee H. C., Das K. S., and Datta C. T. (2010). College Botany Vol. I, II and III. 6th Edition. New Central Book Agency Pvt. Ltd.	

SBT202	Molecular Biology and Genetics	2 Credits
Learning Objectives	➢ **To provide an understanding of the basic molecular processes of a cell at the level of its genome** ➢ **To acquaint the student with the concept of replication of DNA in Prokaryotes and Eukaryotes** ➢ **To offer an understanding of the concept of Population Genetics**	
Course description	**At the end of this course, the student would be able to fully understand the molecular structure of DNA and RNA, and comprehend the basic concept of replication of DNA. The student would also be familiar with the concept of genetic variations in populations and the role of population genetics in Conservation Biology.**	
	THEORY	**(45 lectures)**
Sub Unit	**Unit – I: Nucleotides and Nucleic acids - Blueprint of Life**	**15 lectures**
	a) DNA as genetic material **b) RNA as genetic material** **c) Nucleotides** i) Definition ii) Structures of Purine and Pyrimidine ring and nucleotides iii) Examples of deoxyribonucleotides and ribonuleotides **d) DNA** i) Structure based on Chargaff's rule And Watson and Crick model ii) Properties of DNA iii) Forms of DNA **e) RNA** i) Types of RNA ii) Structure of each type iii) Significance of each type	
	Unit – II: Replication	**15 lectures**
1.	**a) History, Central Dogma** **b) DNA Replication in Prokaryotes** i) Semi-conservative DNA replication ii) DNA Polymerases and its role, *E.coli* Chromosome Replication iii) BidirectionalReplication of Circular DNA molecules. iv) Rolling Circle Replication **c) DNA Replication in Eukaryotes** i) DNA Replication in Eukaryotes ii) DNA Recombination – Holliday Model for Recombination	

	Unit – III: Population Genetics	15 lectures
1.	**a) Genetic Structure of Populations** i) Genotypic Frequencies and Allelic Frequencies ii) Hardy- Weinberg Law and its assumptions **b) Genetic Variations in Populations** i) Measuring Genetic Variation at Protein & DNA level ii) Natural Selection, Genetic Drift and Speciation iii) Role of Population Genetics in Conservation Biology	
CA **(Continuous Assessment)**	CA1- Written test CA 2- Problems	
References:	• Russell P. J. (1998). Genetics. 5th Edition. Benjamin/Cummings Publishing Company Inc. • Russell P. J. (2016). Essential iGenetics. 3rd Edition. Pearson Education. • Maloy S. R., Cronan J. E., and Freifelder D. (2006). Microbial Genetics. 2nd Edition. Narosa Publishing House.	

SBT203	Enzymology, Vitamins and Immunology	2 Credits
Learning Objectives	➢ **To acquaint students with concepts in Enzymology such as nature of enzyme, active sites, enzyme action, regulation and inhibition** ➢ **To enable the student to comprehend the different vitamins and coenzymes** ➢ **To provide a basic understanding of antibodies, antigens and role of immune system**	
Course description	**At the end of this course, the student would be able to understand the nature and action of enzymes, their significance and role of vitamins and coenzymes. Students would also develop understanding of the concept of antigens, antibodies and immunity.**	
	THEORY	**(45 lectures)**
Sub Unit	**Unit – I: Basic Enzymology**	**15 lectures**
1.	**a) Enzymes** i) History ii) Definition, Classification, Nomenclature iii) Chemical Nature, Properties of Enzymes **b) Mechanism of Enzyme Action** i) Concept of activation energy and transition state ii) Active Sites, Enzyme Specificity iii) Cofactors and coenzymes iv) Concept of optimum conditions- Effect of pH, Temperature, enzyme concentration and Substrate Concentration on Enzyme Activity **c) Concept of Enzyme inhibition and activation** i.) Feed back inhibition, Product inhibition, ii.) Allosteric enzymes **d) Isoenzymes** e) **Significance of Enzymes in industry**	
	Unit – II: Vitamins and coenzymes	**15 lectures**
	a) Introduction and Definition i) History and discovery ii) Classification based on solubility b) **Fat soluble vitamins (Structure, Sources, RDA, biochemical functions, related disorders)** i) Vitamin A ii) Vitamin D iii) Vitamin E	

	iv) Vitamin K c) **Water soluble vitamins (Sources, RDA, biochemical functions, related disorders)** i) B complex group vitamins- B_1, B_2, B_3, B_6, B_7, B_{12}, and Folic acid ii) Vitamin C (include structure)	
	Unit – III: Basic Immunology	**15 lectures**
1.	a) **History** b) **Immunity –**First, second and third line of defense **c) Factors Influencing Immunity and Mechanisms of each type** i.) Innate Immunity, ii.) Acquired Immunity, iii.) Local and Herd Immunity iv.) Humoral and Cellular Immunity **d) Antigens** i.) Types of Antigens ii.) General Properties of Antigens iii.) Adjuvants and epitopes **e) Antibodies** i.) Discovery of Antibodies ii.) Structure of Antibodies iii.) Classes and sub classes of Immunoglobulins with their biological activities iv.) Antigenic Determinants on Immunoglobulins	
CA **(Continuous Assessment)**	CA1- Written test CA 2- Case studies, Presentations	
References:	• Nelson D. L., and Cox M. M. (2008). Lehninger Principles of Biochemistry. 5th Edition. W H Freeman and Company. • Satyanarayana U. and Chakrapani U. (2007). Biochemistry. 3rd Edition. Books and Allied (P) Ltd.. • Rao C. V. (2007). Immunology. 2nd Edition. Narosa Publishing House Pvt. Ltd. • Ananthanarayan R. and Panikar C. K. J. (2009). Textbook of Microbiology. 8Th Edition. Universities Press. • Kindt T. J., Goldsby R. A., and Osborne B. A. (2007). Kuby Immunology. 6th Edition. W.H. Freeman And Company.	

SBT204	Tissue Culture and Biostatistics	2 Credits
Learning Objectives	➢ **To aquaint students with the basic concepts in Plant and Animal Tissue Culture** ➢ **To impart the basic skills of PTC and ATC** ➢ **To introduce the usefulness of Statistics in Biological data analysis. To understand the types of data, representation of data and measures of central tendency and dispersion.**	
Course description	**At the end of this course, the importance and implementation of Plant and Animal Tissue Culture techniques would be established. The key points to be noted when practically carrying out these techniques will be understood. Also, the need for Biostatistics and basic application of Biostatistics will be emphasized.**	
	THEORY	**(45 lectures)**
Sub Unit	**Unit – I: Plant Tissue Culture**	**15 lectures**
1.	**a) Introduction** i) Landmark contributions in PTC ii) Cell Theory, Concept of Cell Culture, Cellular Totipotency **b) Organization of Plant Tissue Culture Laboratory** i) Equipments and Instruments ii) Aseptic Techniques: Washing of Glassware, Media Sterilization iii) Aseptic Workstation, Precautions to maintain Aseptic Conditions. **c) Culture Medium** i) Nutritional requirements of the explants, PGR‘s and their in-vitro roles ii) Media Preparation **d) Callus Culture Technique** Introduction, Principle & Protocols	
	Unit – II: Animal Cell Culture	**15 lectures**
1.	**a) Basics of Animal Cell Culture** i) Introduction ii) Advantages and limitations iii) Types of cell culture iv) Applications of cell culture **b) Cell Culture Techniques** i) Laboratory design and layout	

	ii) Equipment and Sterilization Methodology iii) Aseptic technique iv) Culture vessels and substrates v) Nutritional and Physiological: Growth Factors & Growth Parameters **c) Safety, Bioethics and Validation**	
	Unit – III: Biostatistics	**15 lectures**
	a) Introduction i) Definition & Importance of Statistics in Biology ii) Types of Data iii) Types of Population Sampling **b) Normal and Frequency Distribution Representation of Data and Graphs** i) Bar Diagrams, Pie Charts and Histogram, Polygon and Curve **c) Measures of Central Tendency (For Raw, Ungrouped & Grouped Data)** i) Mean, Median, Mode **d) Measures of Dispersion** i) Range, Variance, Coefficient of Variance ii) Standard Deviation, Standard Error	
CA **(Continuous Assessment)**	CA1- Written test CA 2- Quiz	
References:	• Razdan M.K.(2014).An Introduction to Plant Tissue Culture. 2nd Edition. Mudrak Printer. • De K. K. (2013). Plant Tissue Culture. New Central Book agency (P) Ltd. • Jha T. B. and Ghosh B. (2005). Plant Tissue Culture. Basic and Applied. Universities Press India Ltd. • Doods J. H and Roberts L. N. (2004). Experiments in Plant Tissue Culture. 3rd Edition. Published by Press syndicate of the University of Cambridge. • Freshney I. R. (2010). Culture of Animal Cells. 6th Edition. Wiley-Blackwell. • Gangal S. (2010). Principles and Practice of Animal Tissue Culture. 2nd Edition. Universities Press (India) Pvt. Ltd. • Mahajan B. K. (2016). Methods in Biostatistics for Medical Students and Research Workers. Jaypee Brothers Medical Publishers (P) Ltd. • Gurumani N. (2009). An Introduction to Biostatistics. 2nd Revised Edition. MJP Publishers. • Arora P. N. and Malhan P. K. (2013). Biostatistics. 2nd Edition. Himalaya Publishing House.	

SBT205	Macromolecular Chemistry	2 Credits
Learning Objectives	➢ **To familiarize students with Bioorganic Molecules** ➢ **To provide a clear understanding of Classification, Structure and Characterization of Biomolecules** ➢ **To impart knowledge related to biological role of all major biomolecules**	
Course description	**The Bioorganic Chemistry course is designed to impart basic knowledge related to different classes of organic Biomolecules.** **These vital bioorganic compounds play indispensable functions in the cell. Hence a comprehensive understanding of basics of Biomolecules, will prepare students for a future career in industry, research and entrepreneurial endeavor.**	
	THEORY	**45 lectures**
Sub Unit	**Unit – I: Biomolecules: Carbohydrates**	**15 lectures**
1.	a) Structure, Function, Classification b) Characteristic Reactions, Physical and Chemical Properties c) D & L Glyceraldehydes d) Structure of Monosaccharides, Disaccharides, and Polysaccharides e) Isomers of Monosaccharides f) Chemical/Physical Properties of Carbohydrate g) Chemical Reactions for Detection of Mono, Di and Polysaccharides.	
Sub Unit	**Unit – II: Biomolecules: Lipids**	**15 lectures**
	a) Classification of Lipids b) Properties of Saturated, Unsaturated Fatty Acids, Rancidity, and Hydrogenation of Oils c) Triacylglycerol-Structure and Function d) Phospholipids: Lecithin Cephalin, Plasmalogen e) Sterols: Cholesterol: Structure and Function f) Lipoproteins: Structure and Function g) Storage Lipids, Structural Lipids h) Action of Phospholipases	

	Unit – III: Biomolecules: Amino acids and Proteins	
	a) Amino Acids i) Definition, general formula and Peptide synthesis ii) Classification of amino acids based on polarity of R group and Nutritional classification iii) Properties iv) Isoelectric point, concept of isoelectric pH and Zwitter ion v) Titration curve of amino acids (with example) **b) Proteins** i) Classification based on Structure and Functions, Primary Structure ii) N-terminal (Sanger and Edmans Method) and C-terminal Analysis (Enzyme) iii) Reactions of Amino Acids, Sorenson's Titration, Ninhydrin Test iv) Denaturation of protein, Structure of Peptides. v) Glycoproteins	**15 lectures**
CA **(Continuous Assessment)**	CA1- Written test CA 2- Quiz	
References:	• Nelson D. L., and Cox M. M. (2008). Lehninger Principles of Biochemistry. 5th Edition. W H Freeman and Company. • Murray R. (2017). Harper's Illustrated Biochemistry, 27Th Edition, Lange Publication. • Voet D., and Voet J. (2008). Biochemistry. John Willey and Sons, Inc. USA. • Satyanarayana U. and Chakrapani U. (2007). Biochemistry. 3rd Edition. Books and Allied (P) Ltd. • Berg J and Stryer L. (2012). Biochemistry. 7Th Edition. W.H. Freeman and company, NY. • Conn E. E. and Stumpf P. K. (1987). Outlines of Biochemistry. 4th Edition. Willey Eastern Limited.	

SBT206	Physical and Analytical Chemistry	2 Credits
Learning Objectives	➢ **To provide an understanding of chemical kinetics mainly in terms of reaction rates, effect of variables and mechanism of reactions** ➢ **To acquaint students with fundamentals in Oxidation and Reduction Reactions** ➢ **To train the student in the principal, working and applications of basic Analytical Techniques like Chromatography and Colorimetry**	
Course description	**This course is designed to enable the student understand kinetics of various types of chemical reactions, and to distinguish reactions involving oxidation and reduction processes. The student would also be introduced to the understanding and use of two common and significant analytical techniques viz. Chromatography and Colorimetry.**	
	THEORY	**(45 lectures)**
Sub Unit	**Unit I: Chemical Kinetics**	**15 lectures**
1.	**a) Reaction Kinetics** i) Rate of Reaction, ii) Rate Constant, iii) Measurement of Reaction Rates iv) Order & Molecularity of Reaction	
2.	**Integrated Rate Equation of First and Second order reactions** (with equal initial concentration of reactants). (Numericals expected)	
3.	**a) Determination of Order of Reaction by** i) Integration Method ii) Graphical Method iii) Ostwald‘s Isolation Method iv) Half Time Method (Numericals expected)	
Sub Unit	**Unit II: Oxidation and Reduction reactions**	**15 lectures**
1.	**a) Principals of Oxidation & Reduction Reactions** i) Oxidising agents ii) Reducing Agents	
2.	a) **Oxidation Numbe**r i) Rules to assign Oxidation Numbers with examples ii) Ions like Oxalate, Permanganate, and Dichromate	

3.	**Balancing Redox Reactions by Ion Electron Method**	
4.	**Oxidation, Reduction, Addition and Substitution & Elimination Reactions**	
Sub Unit	**Unit – III: Basics of Analytical Chemistry**	**15 lectures**
1.	**Methods of Separation** a) Precipitation b) Filtration c) Solvent Extraction	
2.	**Analytical Techniques: Chromatography** a) Definition, Principles, and types b) Introduction to paper, Thin layer and column chromatography c) Applications	
3.	**Colorimetry** a) Principle; Beer-Lambert's Law and limitations of Beer Lambert's Law b) Measurement of extinction c) Derivation of E = kcl d) Filter selection e) Applications	
CA **(Continuous Assessment)**	CA1 - Written test CA 2 - Problems, Balancing chemical equations.	
References:	**Unit 1 & 2** 1. Lee, J.D. *Concise Inorganic Chemistry*, (1991), ELBS. 2. Douglas, B.E. and McDaniel, D.H., (1970), *Concepts & Models of Inorganic Chemistry* 3. Prakash,S., Tuli, G.D., Basu, S.K., Madan, R.D., *Advanced Inorganic Chemistry*, Volume I 4. Day, M.C. and Selbin, J., (1962), *Theoretical Inorganic Chemistry*, ACS Publications 5. James E. Huheey, *Inorganic Chemistry*, (1983), Harper & Row Publishers, Asia 6. Shriver, D.F., P.W. Atkins, C. H. Langford, 3rd edition, *Inorganic Chemistry*, Oxford University Press 7. Bahl, Tuli and Anand, *Advanced Inorganic Chemistry*, Volume I and II. 8. Manas Chanda,*Atomic structure and chemical bond: Including Molecular spectroscopy*, (1972), McGraw-Hill Inc, US	

	Unit 3: 1. Wilson K., and Walker J. (2010). Principles and Techniques of Biochemistry and Molecular Biology. 7th Edition. Cambridge University Press. 2. Plummer D. T. (1988). An Introduction to Practical Biochemistry. 3rd Edition. Tata McGraw-Hill Publishing Company Ltd.	

Semester 2 Practical

SBTP201	**Cell biology and Plant Physiology Molecular Biology and Genetics** **(Credits : 02; Practicals/Week: 02)**
	1. Study of photomicrographs of cell organelles of plants and animals 2. Study of Hill's Reaction 3. Colorimetric study of absorption spectrum of photosynthetic pigments 4. Activity of salivary amylase on starch 5. Special staining - Cell wall using Chance's method 6. Special staining- Capsule staining using Manewal's method 7. Special staining- Lipid staining using Burdon's method 8. Special staining- Endospore staining using Schaffer and Fulton's method 9. Special staining- Metachromatic granules staining using Albert's method 10. Special staining- Acid fast staining using Ziehl-Neelsen's method 11. Isolation of bacteria- quadrant plate method 12. Enumeration of bacteria – Spread plate method and pour plate method 13. Motility test: stab culture technique/ hanging drop method 14. Extraction of gDNA from moong seeds 15. Study of mitosis using PDB/ Colchicine treated onion root tips 16. Study of meiosis 17. 17. Study of giant chromosome of *Drosophila*
SBTP202	**Enzymology, Vitamins and Coenzymes and Immunology** **Tissue culture and Biostatistics** **(Credits : 02 Practicals/Week: 02)**
	1. Qualitative assay of enzymes Amylase, Lipase, Protease, Urease, Catalase and Dehydrogenase. 2. Study of the effect of pH on enzyme activity 3. Study of the effect of temperature on enzyme activity 4. Study of blood grouping 5. Laboratory organization and layout of Plant and Animal Tissue Culture Laboratory 6. Working and use of various instruments used in Tissue Culture/Biotechnology laboratory. 7. Preparation of stock solutions and preparation of Media for PTC 8. Aseptic transfer technique, Surface sterilization and Inoculation for Callus culture.

	9. Media Preparation and sterilization of ATC media 10. Trypsinization of tissue and Viability count. 11. Biometric analysis for Mean, Median, Mode and Standard Deviation 12. Data representation using Frequency Polygon, Histogram and Pie Diagram.
SBTP203	**Bioorganic Chemistry, Physical and Analytical chemistry** **(Credits : 02; Practicals/Week: 02)**
	1. Spot test for carbohydrates, fats, proteins and amino acids and nucleic acids. 2. Standardization of Colorimeter – Determination of ƛ Max for KMnO4 / CuSO4. 3. Verification of Beer and Lambert's law. 4. Estimation of sugars by DNSA method. 5. Estimation of proteins by Lowry's method. 6. Determination of rate constant for the saponification reaction between ethyl acetate and sodium hydroxide by back titration method. 7. Study the reaction between NaHSO3 and KMnO4 and balancing the reaction in alkaline, acidic and neutral medium. 8. Study the transfer of electrons (Titrate sodium thiosulphate and potassium dichromate). 9. Determination of volume strength of hydrogen peroxide solution by titration with standardized potassium permanganate solution. 10. Determination of acetic acid in vinegar by titrimetric method. 11. Standardization of commercial sample of Sodium hydroxide using Potassium Hydrogen Phthalate. 12. Determination of Fe(II) present in the given sample. 13. Titrimetrically. 13. Determination of amount of NAHCO3+ Na2CO3 in the given solid mixture Titrimetrically. 14. Separation of sugars by paper chromatography. **15.** Separation of amino acids by paper chromatography.