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

Program: B.Sc

Proposed Course: Biotechnology

Semester III

Credit Based Semester and Grading System (CBCS) with effect from the academic year 2020-21

Academic year 2020-21

Semester III			
Course Code	**Course Title**	**Credits**	**Lectures /Week**
SBT301	Cell Biology and Immunology	3	3
SBT302	Molecular Biology	3	3
SBT303	Food and Fermentation Technology	3	3
SBT304	Environmental Biotechnology	3	3
SBT305	Bio-organic Chemistry	3	3
SBT306	Methods in Analytical Chemistry	3	3
SBT307	Scientific Research Methodology	3	3
SBTP301	Practicals of SBT301, 302 and SBT303	2.5	9
SBTP302	Practicals of SBT304, 305 and SBT306	2.5	9

Semester I – Theory

SBT301	Cell Biology and Immunology	3 Credits
Learning Objectives	➢ To provide an understanding of the structure, organization, role, and significance of the eukaryotic cell membrane. ➢ To acquaint students with effectors of immune system, cells and organs of immune system ➢ To enable student understand newer avenues of diagnostics and therapeutics using immunological techniques	
Course description	This course aims to equip the student with a thorough knowledge of the cellular membranes of eukaryotic cell (mainly with reference to mammalian cells). This would lay the foundation to understand the various complexities associated with cell membrane role and its significance in Cell Biology. Students will further develop an understanding of various effectors of human immune system viz. cells and organs of immune system. They would gain an insight of various methods and techniques of immunology and their applications in modern diagnosis and therapeutic monitoring.	
	THEORY	**(45 lectures)**
Sub Unit	**Unit 1: Cell Membrane**	**15 L**
1.	**Introduction:** Overview of Membrane functions; Brief history on studies of plasma membrane structure.	
2.	**Organisation of membrane structure:** Chemical composition of membranes – Lipids, Carbohydrates and Proteins. Membrane proteins (integral, peripheral, lipid-anchored). Membrane lipids and membrane fluidity (importance of membrane fluidity, maintenance of membrane fluidity). Glycocalyx (structure and role).	
3.	**Membrane transport:** Passive, Facilitated diffusion and carrier proteins, Ion channels; Active transport.	
4.	**Endocytosis:** Phagocytosis, receptor-mediated endocytosis, protein trafficking in endocytosis.	

5.	**Cell Junctions, Cell Adhesion and the ECM:** Tight junctions, Gap junctions, Desmosomes and ECM. Plasmodesmata.	
	Unit :2 Cells and organs Immune system	**15 L**
1.	a) Haematopoiesis b) Cells of Immune system; i. Lymphoid cells B lymphocytes, T Lymphocytes, T_H, T_C, CTL, Common Cluster of Differentiation(CD) markers to distinguish functional lymphocyte population, NK cells, ADCC, NKT cells, TCR, Mononuclear phagocytes, Phagocytosis, Granulocytic cells, Mast cells, Dendritic cells (DC), Follicular Dendritic cells c) Mutations/diseases associated with immune cells	
2.	d) Organs of Immune system; i. Primary Lymphoid organs- ii. Thymus, Bone marrow, Lymphatic system ii. Secondary Lymphoid organs- Lymph nodes, Spleen e) Lymphoid tissue- MALT, BALT, GALT,CALT	
3.	f) Antigens, Haptens, Superantigens, Aduvants, Epitopes g) Monoclonal antibodies, Herceptin h) Antibodies, antigenic determinants on immunoglobulins	
	Unit : 3 Techniques in Immunology	**15 L**
	a) Antibody avidity b) Ag- Ab cross reactivity c) Precipitation reactions Immunodiffusion Radial Immunodiffusion Rocket Immunoelectrophoresis Two dimentional electrophoresis Counter-current Immunoelectrophoresis d) Agglutination reactions Hemeagglutination Agglutination inhibition reaction Coomb's Test CFT e) RIA f) ELISA g) Western blotting	

	h) Immunoprecipitation i) Immunofluorescence Direct staining Indirect staining j) CLIA k) Flow cytometry and fluorescence l) Alternatives to Ag- Ab reactions m) Immunoelectron microscopy n) Hybridoma Technology	
CA (Continuous Assessment)	1. CA1- Written test 2. CA 2- Bioexpressions/ Animations/ Nobel Laureates	
References:	1. Karp G. (2010). Cell Biology. International Student Version. 6th Edition. John Wiley and Sons, Inc. 2. Alberts B., Johnson A., Lewis J., Raff M., Roberts K., and Walter P. (2008). Molecular Biology of the Cell. 5th Edition. Garland Science. 3. Cooper G. M., and Hausman R. E. (2009). The Cell – A Molecular Approach. 5th Edition. ASM Press. 4. De Robertis E. D. P. (2001). Cell and Molecular Biology. 8th Edition. Lippincott Williams and Wilkins. 5. Kindt T. J., Goldsby R. A., and Osborne B. A. (2007). Kuby Immunology. 6th Edition. W.H. Freeman And Company. 6. Rao C. V. (2007). Immunology. 2nd Edition. Narosa Publishing House Pvt. Ltd. 7. Abbas A. and Lichtman A. (2014).Cellular and Molecular Immunology. 8th Edition. Elsevier Saunders. 8. Ananthanarayan R. and Panikar C. K. J. (2009). Textbook of Microbiology. 8Th Edition. Universities Press. 9. Satyanarayana U. and Chakrapani U. (2007). Biochemistry. 3rd Edition. Books and Allied (P) Ltd. 10. Nelson D. L., and Cox M. M. (2008). Lehninger Principles of Biochemistry. 5th Edition. W H Freeman and Company 11. Pathak S. and Palan U.(2005) Immunology: Essential and Fundamental. Science Publishers, U.S.; 2nd Revised edition edition (1 February 2005) **ISBN-10:**1578083796; ISBN-13:97857883794	

SBT302	Molecular Biology	3 Credits
Learning Objectives	➢ To provide an understanding of the process of gene expression, and translation of the genetic code in both prokaryotes and eukaryotes. ➢ To acquaint the student with the concept of mutation in DNA and the repair processes involved.	
Course description	At the end of this course, the student would be able to fully understand and comprehend the processes involved in both gene expression and protein formation from mRNA. The student would also be familiar with the events of possible mutations in the DNA molecule with specific ways that a cell resorts to for repair of damaged DNA.	
	THEORY	**(45 lectures)**
Sub Unit	**Unit 1: Transcription**	**15 L**
1.	**Gene Expression- an Overview:** The Central Dogma, Overview of transcription process – RNA synthesis. Classes of RNA.	
2.	**Transcription Process in Prokaryotes :** RNA polymerases; Promoters and Enhancers; Initiation of Transcription at Promoters; Elongation and Termination of an RNA Chain. Coupled transcription-translation. Crispr.	
3.	**Transcription in Eukaryotes :** Eukaryotic RNA Polymerases; Eukaryotic Promoters; Superenhancers; Transcription of Protein Coding Genes by RNA Polymerase; Eukaryotic mRNAs; miRNAs, siRNAs, Transcription of other genes; Introns and Exons; Spliceosomes; RNA editing.	
Sub Unit	**Unit 2: Translation**	**15 L**
1.	**Introduction:** Chemical and molecular structure of proteins. Nature of the genetic code – properties of the genetic code; deciphering the code.	**15 L**
2.	**Translation of the genetic message:** Aminoacyl-tRNA molecules; Initiation of translation; Elongation of the polypeptide chain; Termination of translation.	

3.	**Protein sorting in the cell:** Transport of proteins – general; to the endoplasmic reticulum; chloroplasts and nucleus.	
Sub Unit	**Unit 3: Mutation and DNA repair**	**15 L**
1.	**Definition and Types of Mutations:** Mutagenesis and Mutagens. (Examples of Physical, Chemical and Biological Mutagens) Types of mutations. Causes (spontaneous, induced)	
2.	**Mutagens:** Mode of Action. Screening for potential mutagens.	
3.	**DNA repair mechanisms:** Direct correction of mutational lesions. Repair involving excision of base pairs. Human genetic diseases resulting from DNA replication and repair errors.	
4.	**Screening procedures for isolation of mutants:** Visible mutations; Nutritional mutations; Conditional mutations; Modern molecular screens. Ame's test, Herd's test.	
CA **(Continuous Assessment)**	1. CA1 – Written test 2. CA 2 – Study and present report (using examples from products used which could be potential mutagens)	
References:	1. Russell P. J. (1998). Genetics. 5th Edition. Benjamin/Cummings Publishing Company Inc. 2. Russell P. J. (2016). Essential iGenetics. 3rd Edition. Pearson Education. 3. Snustad P. D., and Simmons M. J. (2010). Principles of Genetics. 5th Edition. John Wiley and Sons, Inc. 4. Maloy S. R., Cronan J. E., and Freifelder D. (2006). Microbial Genetics. 2nd Edition. Narosa Publishing House.	

SBT303	Food and Fermentation Technology	3 Credits
Learning Objectives	➢ To acquaint students with the basic concepts and techniques in food and fermentation technology. ➢ To understand the usefulness of various applications in the food and fermentation industry.	
Course description	The aim of this course is to provide an exhaustive understanding of the various ways in which Biotechnology is involved in the food and fermentation industry. This will enable the student to appreciate the usefulness of microbes, plants and animal cells in the food and fermentation industry and thus have a mindset equipped for newer discoveries/inventions.	
	THEORY	**(45 lectures)**
Sub Unit	**Unit 1: Food Technology I**	**15 L**
1.	**Food Biotechnology:** Traditional and modern; Food security; Genetic modification of food – concerns and measures undertaken.	
2.	**Foods:** Classes of foods. Genetically engineered plants and foods (GMO derived foods, foods containing genetically modified materials, developments in the seed industry, and improvements of plants. Bioethics in plant genetic engineering. Genetically modified crops).	
3.	**Microorganisms and food:** Fermentation. Spoilage. Food hazards. Factors affecting the growth and survival of microorganisms in food (microbial growth, intrinsic factors, extrinsic factors, implicit factors). Predictive food microbiology.	
4.	**Food preservation, processing and packaging:** Heat, Irradiation, High-pressure, Low-temperature, Chemical preservatives, Modification of atmosphere, Control of water activity, Compartmentalization. HACCP and QACCP, reduced oxygen packaging, modified atmosphere packaging, films, pickling, vacuum and drying.	

Sub Unit	Unit 2: Food Technology II	15 L
1.	**Fermented and microbial foods:** Yeasts, lactic acid bacteria. Fermented milks, cheese, fermented plant products, fermented meats, fermented fish, beer, vinegar, mould fermentations.	
2.	**Microbiological examination of foods:** Direct, Cultural, Enumeration, Alternative methods, Rapid methods.	
3.	**Dairy Microbiology:** Microflora of raw milk, Starter cultures and their use, fermented milks and cream (types of fermented milks; examples – yoghurt and dahi), Cheese products (rennet curd, acid curd, acid-heat coagulated – one example each)	
4.	**Modern trends in food technology:** Functional foods; Biofortication; Nutraceuticals; Gut microbiome; Probiotics and prebiotics; Processed and convenience foods; Space foods; Food fortification, Hydroponics.	
	Unit 3: Fermentation Technology	**15 L**
1.	Primary screening, secondary screening, inoculum and Screening, inoculum and strain development strain development. Scale up, scale down	
2.	Wine and Beer: Introduction, manufacturing/processing, spoilage.	
3.	Malo-lactic fermentation, Industrial Fermentations Production of : Penicillin, Streptomycin, Vinegar, Citric acid Single cell protein (Mushroom). Solid state fermentation.	
4.	Introduction of DSP: Foam separation, Types of Precipitation, Downstream processing Filtration, Centrifugation, Chromatography in DSP Cell disruption- physical and chemical methods. Solvent recovery, Membrane processes, Drying, Crystallization and Whole broth processing. Mammalian cell bioreactors (e.g. production of monoclonal antibodies).	

CA **(Continuous Assessment)**	1. CA1 – Written test. 2. CA 2 – Model making (processes).
References:	1. Adams M. R., Moss M. O. and McClure P. (2016). Food Microbiology. 4th Edition. Royal Society of Chemistry. 2. Mehta V. (2006). Food Biotechnology. Campus Books International. 3. Canon B. (2014). Fundamentals of Food Biotechnology. Agrotech Press. 4. SriLakshmi B. (2010). Food Science. 5th Edition. Newage International Publishers. 5. Marth E. H., and Steele J. L. (2005). Applied Dairy Microbiology. 2nd Edition. CRC Press. 6. Frazier W. C., and Westhoff D. C. (2014). Food Microbiology. 5th Edition. McGraw Hill Education. 7. Waites M. J., Morgan N. L., Rockey J. S., and Higton G. (2002). Industrial Microbiology – an introduction. Blackwell Publishing.

SBT304	Environmental Biotechnology	3 Credits
Learning Objectives	➢To acquaint students with basic concepts in water potability and assessment of water quality using various laboratory methods. ➢To enable the student understand significance and methods of effluent, solid waste and industrial waste management. ➢To provide a basic understanding of environmental biotechnology.	
Course description	Through this course the students will develop understanding of the concept of potable water and assessment of water quality. Further they will be acquainted with various ways of treatment of Municipal waste water, industrial waste and solid waste management. At the end of this course, the student would be able to understand the sources of pollution, hazardous effects of pollution on human life and environment, need and modern methods of for environmental conservation.	
	THEORY	**(45 lectures)**
Sub Unit	**Unit 1: Water Biotechnology**	**15 L**
1.	Potable water- Meaning and concept , Current BIS guidelines, Water standards applicable in western countries like USA, UK.	
2.	Assessment of quality of water, MPN, Confirmatory and completed test, Fecal contamination of water; Newer techniques of potable Water purification- UV, Sand filters,	
3.	Effluent treatment Treatment Types- primary treatment: Meaning and significance Monitoring criteria - pH, temp, TSS, TDS, TS, BOD, COD and heavy metals. Case study (Ganga) Primary treatment Methods, Precipitation, Flocculation, Sedimentation tank Secondary treatment Methods– Microbiological treatment, oxidation ponds, Lagoons, Imnhoff tank Tertiary treatment methods- modern approaches in effluent treatment. Practical challenges in decreasing TDS (zero	
4.	Solid waste management- bio gas technology; Composition of biogas and Deenbandhu Biogas plant. Biocompost, Vermicompost.	

	Unit 2: Industrial waste management	**15 L**
1.	Hazards associated with untreated waste Impact on human life and environment; Case studies	
2.	Industrial Waste- Characteristics and Nature Treatment approaches for various industrial waste; Pharmaceutical waste treatment Treatment of Dairy industry waste Treatment of Brewery , winery and Distillery industry waste Treatment of Paper and pulp waste Treatment of Oil refinery waste Treatment of wastes from Dye industry Treatment of wastes from Textile industry. Electronic waste management (Use of case studies to understand implications of untreated waste water)	
	Unit 3: Current Trends in Environmental Biotechnology	**15 L**
1.	Bioremediation- Phytoremediation and microbial remediation. GMOs in bioremediation, Superbug *Pseudomonas*.	
2.	Production, application, advantages and limitations of Biofertilizers and Biopesticides, Petrocrops, Biofuels, Ethanol as a green fuel. Biopolymers and Bioplastics.	
3.	Concept of air, water and soil pollution; Climate change; Soil and Water scarcity, Oil spills. Conservation practices- needs and methods , newer approaches Sustainable development- Meaning, concept and methods. Vertical gardens, Recycling, Replacing non biodegradable plastics. Concept of Carbon foot print and carbon credit	

CA **(Continuous Assessment)**	1. CA1- Written test 2. CA 2- Report writing, case study
References:	1. Pelczar M.J., Chan E.C.S., Kreig N.R. (2006). Microbiology. 6th Edition. The Mc Grew Hill Companies Inc., NY. 2. Willey J. M., Sherwood L., Sherwood L. M., Woolverton C. J., Woolverton C. Prescott's Microbiology. (2010). 8th Edition. McGraw Hill. 3. Fulekar M. H. (2010). Environmental Biotechnology. CRC Press. 4. Indu Shekhar Thakur Industrial Waste Management

SBT305	Bio-organic Chemistry	3 Credits
Learning Objectives	➢ To familiarize students with pathays leading to breakdown of Bioorganic Molecules in cellular environment ➢ To provide a clear understanding of energy transactions involved in bio molecular catabolism ➢ To impart knowledge related to Enzyme kinetics	
Course description	The Molecules of Life course is designed to impart basic knowledge related to cellular catabolism of different organic Biomolecules. The students wll also develop an understanding of cellular energetic and the role of regulatory enzymes in catabolism. At te end of this course the students will develop greater understanding of enzyme kinetics. These vital bioorganic compounds play indispensable functions in the cell. Hence a comprehensive understanding of basics of catabolism of Biomolecules and enzyme kinetics, will prepare students for a future career in industry, research and entrepreneurial endeavour.	
	THEORY	**45 lectures**
Sub Unit	**Unit 1: Biomolecules: Carbohydrates Catabolism**	**15 L**
1.	i. Emp pathway and Energetics ii. Role of PDH complex iii. HMP shunt and role of NADP	
2.	i. TCA cycle and Energetic ii. Amphibolic nature of TCA iii. Significance of TCA in Metabolism	
3.	i. OP and SLP ;Role in cellular energetics ii. ETC- Organization, components, and complexes iii. Enzymes linked to ETC	
	Unit 2: Biomolecules: Lipid Catabolism	**15 L**
1.	i. Lipolysis; Lipase action ii. Transport and activation of fatty acids	
2.	i. β- Oxidation and energetics ii. α-Oxidation iii. ω- Oxidation	
3.	i. Oxidation of unsaturated fatty acids	

	Unit 3: Enzyme kinetics	15 L
1.	i) Concepts in enzyme kinetics; ii) Effect of enzyme and substrate concentrations on the rate of an enzyme catalysed reaction, iii) Derivation of Michaelis- Menten equation iv) Lineweaver Burke plot, v) Concept and Significance of V_{max} and K_m,	
2.	i) Enzyme inhibition: Reversible and irreversible inhibition ii) Competitive, Noncompetitive, Uncompetitive and mixed inhibition Applications of enzyme inhibition.	
3.	i. Reaction mechanism for chymotrypsin, Hexokinase Enolase, and Lysozyme ii. Regulatory enzymes – role in metabolic pathways with examples iii. Enzyme purification (use of IU); specific activity; Immobilised enzymes.	
CA **(Continuous Assessment)**	1. CA1- Written test 2. A 2- Presentations / Survey / Debate	
References:	1. Nelson D. L., and Cox M. M. (2008). Lehninger Principles of Biochemistry. 5th Edition. W H Freeman and Company. 2. Murray R. (2017). Harper's Illustrated Biochemistry, 27Th Edition, Lange Publication. 3. Voet D., and Voet J. (2008). Biochemistry. John Willey and Sons, Inc. USA. 4. Satyanarayana U. and Chakrapani U. (2007). Biochemistry. 3rd Edition. Books and Allied (P) Ltd. 5. Berg J and Stryer L. (2012). Biochemistry. 7Th Edition. W.H. Freeman and company, NY. 6. Conn E. E. and Stumpf P. K. (1987). Outlines of Biochemistry. 4th Edition. Willey Eastern Limited.	

SBT306	Methods in Analytical Chemistry	3 Credits
Learning Objectives	➢ To provide an understanding of spectroscopic techniques ➢ To acquaint students with fundamentals in techniques used in understanding and studying biomolecules like nucleic acids and proteins suing electrophoresis ➢ To train the student in the principles and applications of Centrifugation technique.	
Course description	This course is designed to enable the student understand principles and applications of Spectroscopy, electrophoresis and Centrifugtion.	
	THEORY	**(45 lectures)**
Sub Unit	**Unit I: Spectroscopy**	**15 L**
1.	**Introduction:** Types and properties of spectra; Basic Laws of light absorption	
2.	**Spectrophotometer:** Principle, basic Instrumentation Applications of Spectroscopy in research and industry Precautions while using spectroscopy Comparison of colorimeter and spectrophotometer	
3.	UV-Vis Spectrophotometer, Single and Dual Beam Spectrophotometer.	
4.	Other types of spectroscopy – Mass Spectroscopy, Nuclear Magnetic Resonance Spectroscopy, Acoustic Resonance Spectroscopy; IR; Atomic; Raman Spectroscopy.	
Sub Unit	**Unit II: Electrophoresis**	**15 L**
1.	Electrophoresis; concept and basic principles; Migration of ions in an applied electric field; Factors affecting electrophoretic mobility; Moving boundary electrophoresis.	
2.	Concept and types of support matrix; Paper electrophoresis, AGE, native PAGE, SDS-PAGE, Continuous and discontinuous electrophoresis IEF and 2D gel electrophoresis(just overview)	
3.	Gel documentation system. Applications of electrophoresis in academics, research and industry.	

Sub Unit	Unit – III: Centrifugation	15 L
1.	Introduction: Principle of centrifugation.	
2.	Rotor design and selection. Preparative centrifugation - differential, rate-zonal, isopycnic, equilibrium isodensity centrifugation with applications.	
3.	Density gradient centrifugation – nature of gradient, formation, sample application and collection.	
CA **(Continuous Assessment)**	1. CA1 - Written test 2. CA 2 – Assignments (application based)	
References:	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. 3. Upadhyay A., Upadhyay K. and Nath N. (2016). Biophysical Biochemistry: Principles and Techniques. Himalaya Publishing House. 4. Morrison R.T., Boyd R.N., and Bhatacharjee S.K. (2011). Organic Chemistry. 7th Edition. Pearson Education 5. Solomon T.W.G. and Fryhle C.B. (2008). Organic Chemistry. 9th Edition. John Wiley & Sons.	

SBT307	Scientific Research Methodology	3 Credits
Learning Objectives	➢ To inculcate research aptitude and to provide basic understanding of Research ➢ To acquaint students with basic principles and scope of Research Methodology through actual process ➢ To enable student understand the application of computational tools in Scientific research and presentation	
Course description	This course is designed to enable the student understand the meaning and importance of research To enhance their research aptitude and motivate them to undertake a research project, stepwise building an understanding of research project. To inculcate presentation skills through computational tools.	
	THEORY	**(45 lectures)**
Sub Unit	**Unit 1: An introduction to Research**	**15 L**
1.	Meaning of research Need and general objectives of research Significance of research (emphasis on Biotechnology) Motivation in Scientific research, criteria of good research	
2.	Types of research and Research approaches Research Methods and methodology Scientific methods of research and research process	
3.	Current Research-Indian scenario, Latest trends and major contributors in biotechnology research	
Sub Unit	**Unit 2: Scientific Research Methodology**	**15 L**
1.	Research Problem- Definition and Selection of a Scientific problem Techniques of defining a research problem (Explain using conventional and modern illustrations).	
2.	Research design- Meaning and need of research design Principles and features of a good design Important concepts for developing a research plan	

3.	Experimental plan and design Methods of collection of primary data-Observation method, interview method and design, questionnaire method and design, Other approaches for primary and secondary data, Case study method	
4.	Designing a Research project - Hands on.	
Sub Unit	**Unit – III: Scientific Research report writing**	**15 L**
1.	Basic skills in computers. Computer software and hardware (overview). MS Office – Word, Excel, Power Point (Only practical). Internet and browsing.	
2.	Publication basics: meaning, types, referencing, online resources. Report writing and scientific paper writing – precautions, bibliography. Oral scientific presentations – Use of power point, videos, animations. Poster presentations – designing presentations using power point, ready templates and basics of coral draw. Ethical issues in research publications – plagiarism: meaning, types and consequences, case studies.	
3.	**Online Resources:** PubMed, Researchgate, J-Gate, PMC. How to read a research paper. Submission of Research project report and presentation.	
CA **(Continuous Assessment)**	1. CA1 – Written test 2. CA 2 – Research Projects	
References:	1. Kothari C. R., and Garg G. (2015). Research Methodology – Methods and techniques. 3rd Edition. New Age International Publishers. 2. Online resources.	

SEM III Biotechnology Practical Syllabus

Academic year 2018-2019

Course Code	Course Title	Credits
SBTP301	Cell Biology, Immunology, Molecular Biology, Food and Fermentation Biotechnology	2.5
SBTP302	Environmental Biotechnology, Bioorganic and Analytical Chemistry	2.5

Semester I – Practical

SBTP301	**Cell Biology, Immunology, Molecular Biology, Food and Fermentation Biotechnology** **Credits :2.5**
	1. Study of thymus, spleen and lymph nodes from permanent slides 2. Total RBC count 3. Total WBC count 4. Differential WBC count 5. Isoagglutination titer 6. Ouchterlony method 7. Blood grouping 8. Study of Cell junctions (Permanent slides) 9. Osmotic fragility of RBCs 10. Study of permeability of beetroot membranes 11. ELISA – demonstration (Kit based) 12. Isolation and gram staining of microorganisms from milk /curd / ice-cream samples 13. Study of probiotic microorganisms from idli-dosa batter 14. Testing of Milk: MBRT, 15. Testing of Milk: RRT, 16. Testing of Milk: Phosphatase test 17. Study of food spoilage 18. Study of food adulteration 19. Field trip to a Research institute/ water treatment plant/ dairy and report writing

SBTP302	**Environmental Biotechnology, Bio-organic and Analytical Chemistry** **Credits :2.5**
	1. Water analysis- Total count/ Viable count/ Heterotrophic count 2. Water potability tests 3. Chemical tests for water potability 4. MPN- Presumptive, Confirmatory, Completed tests 5. Analysis of fecal contamination of water- study of anaerobes 6. BOD 7. COD 8. Study of air microflora 9. Winogradsky's column 10. Determination of Soil pH 11. Contact slide technique 12. Study of nitrifiers and nitrosifiers using chemical and microbiological methods 13. Determination of serum cholesterol 14. Determination of optimum pH of jackbean urease/ Sweet potato amylase 15. Determination of optimum temperature of jackbean urease/ Sweet potato amylase 16. Effect of substrate variation on the rate of amylase catalysed reaction. 17. Determination of Km, and Vmax using MM Plot 18. Determination of Km, and Vmax using LB plot 19. Study of inhibitor action on the rate of amylase catalyzed reaction 20. Preparation of buffers- acetate, Phosphate, bicarbonate and Tris 21. Demonstration of PAGE 22. Demonstration of AGE 23. Staining reagents used in electrophoresis-Composition of Coomasie Brilliant blue, silver nitrate, Ethidium Bromide, Gel Red, Ponceau. 24. Density Gradient Centrifugation

Evaluation Scheme

[A] Evaluation scheme for Theory courses

I. Continuous Assessment (C.A.) - 40 Marks

(i) C.A.-I : Test – 20 Marks of 40 mins. duration

(ii) C.A.-II : Assignment/Projects/ Presentations etc

II. Semester End Examination (SEE)- 60 Marks

[B] Evaluation scheme for Practical courses

(i) Internal Practical

(ii)Semester End Practical