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 4

Biotechnology

Credit Based Semester and Grading System (CBCS)

With effect from the academic year 2019-20

SYBSc Biotechnology Syllabus

Academic year 2019-2020

Semester 4

COURSE CODE	COURSE TITLE	CREDITS	LECTURE/ WEEK
SBT401	Molecular Immunology and Cytoskeleton	03	03
SBT402	Gene Regulation and Cloning Tools	03	03
SBT403	Medical Microbiology	03	03
SBT404	Eukaryotic Genetics and Biostatistics	03	03
SBT405	Applied Chemistry – I	03	03
SBT406	Applied Chemistry – II	03	03
SBT407	Entrepreneurship and IPR	03	03
SBTP401	Practical of SBT401, SBT402, SBT403	2.5	09
SBTP402	Practical of SBT404, SBT405, SBT406	2.5	09

SEMESTER 4

SBT401	**Molecular Immunology and Cytoskeleton**	**3 Credits**
Learning Objectives	➢ **To provide insight of role of MHC and Complement in immune response and to develop understanding of the process of Antigen presentation** ➢ **To provide details of structure and activation process of T cell receptors and B cell receptors and their interactions.** ➢ **To present an understanding of the structure, organization, role, and significance of the cytoskeleton in the functioning of a cell.**	
Course description	**This course aims to impart an in-depth understanding of Role of MHC I and II, Complement pathways and the process of antigen presentation for imparting immunological responses.** **This course will equip students with greater understanding of structure and activation process of T and B cell surface receptor complexes. It will also cover T and B cell interactions.** **This course aims to provide the student with a thorough knowledge of the cytoskeleton of mammalian cells in order to understand and appreciate the immense role and significance of the cytoskeleton during various cellular processes.**	
	THEORY	**(45 lectures)**
Sub Unit	**Unit 1: TLR, Complement, APC and MHC**	**15 lectures**
1.	General Organisation and inheritance of MHC/ HLA MHC I MHC II Genetic map of MHC genes- an overview Expression and regulation of expression of MHC genes MHC and susceptibility of diseases	
2.	Role of antigen presenting cells Endogenous and Exogenous pathway	
3.	Components of Complement Classical pathway, Alternate Pathway and Lectin pathway	

	Functions of Complement	
	Innate immunity - Adaptive –T cell response and B cell Response	
Sub Unit	**Unit 2: Lymphocyte Receptors**	**15 lectures**
1.	TCR complex- TCR-CD3 T-Cell Accessory membrane molecule; CD4 and CD8 Coreceptor Three dimensional structure of TCR-Peptide-MHC complexes	
2.	T cell maturation in thymus T cell Activation T cell Differentiation Cell death and T- cell population	
3.	B-cell Maturation B Cell Activation and proliferation Humoral Responses Affinity maturation Regulation of Immune effector responses	
4.	**Brief concept of T and B cell Interaction**	
Sub Unit	**Unit 3: Cytoskeleton**	**15 lectures**
1.	**Introduction:** Overview of the cytoskeleton. Major functions of the cytoskeleton.	
2.	**Microtubules**: Structure and composition. Dynamic properties of microtubules. MTOCs. MAPs – significance and role (mitosis, structural support, intracellular motility).	

3.	**Microfilaments**: Structure and composition. Assembly and disassembly. ABPs – types, significance and role.	
4.	**Motor proteins**: Kinesin, Dynenin, Myosin.	
5.	**Cytoskeleton and motility**: Microtubules in cilia and flagella. Microfilament and role in muscle contractility – sliding filament model. Examples of non –muscle motility.	
6.	**Intermediate filaments**: Structure and composition. Assembly and disassembly. Types and functions.	
CA **(Continuous Assessment)**	CA1- Written test CA 2- **Review / Summary of Research paper (Unit 1/ 2)**	
References:	• Karp G. (2010). Cell Biology. International Student Version. 6th Edition. John Wiley and Sons, Inc. • Alberts B., Johnson A., Lewis J., Raff M., Roberts K., and Walter P. (2008). Molecular Biology of the Cell. 5th Edition. Garland Science. • Cooper G. M., and Hausman R. E. (2009). The Cell – A Molecular Approach. 5th Edition. ASM Press. • De Robertis E. D. P. (2001). Cell and Molecular Biology. 8th Edition. Lippincott Williams and Wilkins. • Kindt T. J., Goldsby R. A., and Osborne B. A. (2007). Kuby Immunology. 6th Edition. W.H. Freeman And Company. • Rao C. V. (2007). Immunology. 2nd Edition. Narosa Publishing House Pvt. Ltd. • Abbas A. and Lichtman A. (2014). Cellular and Molecular Immunology. 8th Edition. Elsevier Saunders. • Ananthanarayan R. and Panikar C. K. J. (2009). Textbook of Microbiology. 8Th Edition. Universities Press. • Satyanarayana U. and Chakrapani U. (2007). Biochemistry. 3rd Edition. Books and Allied (P) Ltd. • Nelson D. L., and Cox M. M. (2008). Lehninger Principles of Biochemistry. 5th Edition. W H Freeman and Company	

SBT402	Gene Regulation and Cloning Tools	3 Credits
Learning Objectives	➢ **To provide an understanding of the process of gene regulation in both prokaryotes and viral system** ➢ **To acquaint the student with the concept of gene cloning as a molecular technique.**	
Course description	**At the end of this course, the student would be able to fully understand and comprehend the processes involved in both regulation of expression, concept of operon system and their role in regulation of gene expression.** **The topic of gene cloning would help the student know the basics of the technique involved viz. the tools employed - the kind of enzymes and the vectors commonly used.**	
	THEORY	**(45 lectures)**
Sub Unit	**Unit 1: Regulation of Gene expression**	**15 lectures**
1.	**Lac Operon** Lac Operon of of *E. Coli,* Lactose as a carbon source. Experimental evidence for regulation of lac genes. Mutations affecting gene expression - operation mutations and promoter mutations. Positive control of lac Operon; CAP and cAMP. Molecular details of lac Operon.	
2.	**Trp Operon** Organization of Tryptophan biosynthesis genes. Regulation of expression of trp Operon. Antitermination and termination of trp Operon.	
3.	**Regulation of λ phage gene expression** Genetic map of λ phage. Early transcription events. Lysogeny pathway in *E. coli* host. Lytic pathway in *E. coli* host.	
Sub Unit	**Unit 2: Enzymes in Gene cloning**	**15 lectures**
1.	**Restriction endonucleases:** Types, nomenclature, target sites,	

	nature of cut ends, host control restriction and modification, star activity, isoschizomers, application of restriction enzymes.	
2.	**Ligases**: Activity, blunt and sticky end ligation, source and applications.	
3.	**DNA polymerase** with applications – Klenow fragment (synthesis of probe using random priming and nick translation). T_4 DNA polymerase, Taq polymerase.	
4.	**Nucleases**: DNase I, S1 nuclease, mung bean nuclease, RNase H.	
5.	**Other enzymes** - source, mode of action and applications: Alkaline phosphatases; Polynucleotide kinase, terminal transferase, reverse transcriptase.	
Sub Unit	**Unit 3: Cloning Vectors**	**15 lectures**
1.	**Plasmids as cloning vectors**: Classification of plasmids. High and low copy number plasmids (regulating factor). Criteria for plasmid cloning. pUC 19 and pBR322.	
2.	**Virus-based vectors** (Lambda phage as a vector). **M13 and Phagemid-based vectors**:	
3.	**Cosmid based vectors**	
4.	**Large insert capacity vectors** (MACs, PACs and YACs).	
5.	**Yeast Artificial Chromosome (YAC) vectors**.	
6.	**Vectors used in eukaryotes** (YEp, Ti plasmid). Delivery of vectors into eukaryotes. Shuttle vectors.	
7.	**Expression vectors pET.**	
CA (Continuous	CA1- Written test CA 2- Infograph (Unit 2 / 3)	

Assessment)		
References:	• Russell P. J. (1998). Genetics. 5th Edition. Benjamin/Cummings Publishing Company Inc. • Russell P. J. (2016). Essential iGenetics. 3rd Edition. Pearson Education. • Snustad P. D., and Simmons M. J. (2010). Principles of Genetics. 5th Edition. John Wiley and Sons, Inc. • Maloy S. R., Cronan J. E., and Freifelder D. (2006). Microbial Genetics. 2nd Edition. Narosa Publishing House. • Purohit S. S. (2010). Biotechnology. 4th Edition. Student Edition. • Glick B. R., Pasternak J. J. and Patten C. L. (2010). Molecular Biotechnology. 4th Edition. ASM press. • Wilson K., and Walker J. (2010). Principles and Techniques of Biochemistry and Molecular Biology. 7th Edition. Cambridge University Press. • Primrose S. B., and Twyman R.M. (2014). Principles of Gene Manipulation. 7th Edition. Wiley Blackwell.	

SBT403	Medical Microbiology	3 Credits
Learning Objectives	➢ **To study the distribution pattern of diseases in a defined population** ➢ **To understand the concept of pathogenicity of an etiological agent for a disease**	
Course description	**After completion of this course, students would be able to give details on the causal organism, progression of diseases and prophylaxis associated with respiratory tract, GI tract and urinary tract infections. They would also be able to differentiate in disease patterns of bacteria, viruses, prions and protists.**	
	THEORY	**(45 lectures)**
Sub Unit	**Unit 1: Overview of Medical Microbiology**	**15 lectures**
1.	**Normal microbiota of human body:** Origin of normal flora, Gnotobiotics, Distribution and occurance of normal flora in skin, eye, respiratory tract, mouth, GI tract.	
2.	**Principles of Disease:** Koch's postulates, Classification of disease, Pattern and spread of disease, Nosocomial infections.	
3.	**Mode of transmission of infection:** Air borne diseases, Arthropod borne diseases, Direct contact diseases, Sexually transmitted diseases, Food borne and Water borne diseases.	
4.	**Pathogenicity:** Portal of entry, Bacterial virulence factor, Pathogenic properties of fungi, helminths and algae, Portal of exits.	
5.	**Diagnosis:** Conventional, Immunology, Molecular diagnosis.	
6.	**Prophylaxis:** General measures, chemoprophylaxis and vaccines.	
7.	**Epidemiology:** Terminology, Disease reservoirs and epidemics, The host community, Current epidemics, Public health measures.	

Sub Unit	Unit 2: Infectious Agents – I	15 lectures
1.	**Study of virulence factors, pathogenicity, diagnosis, treatment, prophylaxis for the diseases caused by bacteria** **Respiratory tract -** *Streptococcus* spp **,** *Mycobacterium* spp **GI tract -** *Salmonella* spp., *(Shigella* spp.,*Vibrio)* **UTI -** *Escherichia* spp, *Pseudomonas* spp **Skin -** *Staphylococcus* spp, **CNS –** *Clostridium***.**	
2.	**Study of fungal infections caused by** *Trichoderma* spp., *Candida* spp., *Tinea* spp.	
Sub Unit	**Unit 3: Infectious Agents – II**	**15 lectures**
1.	**Virus infections** – Classification of viruses **Study of causative agent, pathogenicity, diagnosis, treatment, prophylaxis** **Air borne (Respiratory) -**Influenza, Polio, SARS **Food and Water borne** - Hepatitis **Vector borne** - Rabies and Dengue (review article) **Sexually transmitted-** HIV, Herpes, Hepatitis	
2.	**Oncogenic viruses and Prions** Transformation of normal cells into tumor cells, DNA oncogenic viruses, RNA oncogenic viruses, prion formation, prion diseases of humans.	
3.	**Study of Protozoal Infections:** Amoebic dysentery Malaria	

CA **(Continuous Assessment)**	CA1- Written test CA 2- Case study	
References:	• Tortora G. J., Funke B.R., Case C. L. Microbiology an introduction (2012) 9th Edition, Pearson Education, Inc. • Willey J. M., Sherwood L., Sherwood L. M., Woolverton C. J., Woolverton C. Prescott's Microbiology. (2010). 8th Edition. McGraw Hill. • Madigan M. T., Martinko J. M. Bender K. S., Buckey D.H., Stahl D. A. Brock Biology of Microorganisms (2015) 14th Edition. Boston: Pearson • Karen C., Morse A., Jawetz, Melnick and Adelberg's Medical Microbiology (2016). 26th Edition. McGraw Hill Education Lange publication. • Ananthnarayan R., Paniker C.K.J. Ananthanarayan and Paniker's Textbook of Microbiology (2017) 10th Edition, University Press (India) Pvt. Ltd. • Stanier R. Y., Ingraham J. L., Wheelis M. L., Painter P. R. (2005). General Microbiology, 5th Ed., Macmillan Press Ltd.	

SBT404	Eukaryotic Genetics and Biostatistics	3 Credits
Learning Objectives	➢ **To provide an understanding about the concept of chromosomal inheritance and genetic recombination.** ➢ **To give the students about basic understanding of Eukaryotic gene mapping and frame different ways of mapping.** ➢ **To equip the student with the tools used in analyzing biological data.**	
Course description	**This course aims to provide the student with a thorough knowledge of chromosomal theory of heredity and genetic linkage and recombination.** **After completion of this course, students would be able to develop thorough knowledge of gene mapping, gene segregation, pattern of sex linked inheritance.** **The topic of biostatistics aims at ensuring that the student is able to use his/her understanding of Biology to design experiments, as well as draw biostatistically valid and meaningful interpretations and conclusions from the data obtained.**	
	THEORY	**(45 lectures)**
Sub Unit	**Unit 1: Genetics-I**	**15 lectures**
1.	**Chromosomal Basis of Inheritance, Sex linkage, Sex Determination:** Eukaryotic Chromosome, Meiosis (in plants and animals), gene segregation in meiosis. Sex chromosome and linkage, Non disjunction of X- chromosome, Genotypic sex determination (Mammals, Drosophila, plants), Sex linked inheritance (X & Y linked).	
2.	**Mechanism and Type of recombination:** Breakage, Reunion, copying in recombination, complete copy choice. Type of recombination: General and Holliday model (strand breakage, pairing, invasion/ assimilation, branch migration), Chaisma, breakage reunion, gene conversion, mismatch repair. Site specific recombination.	

Sub Unit	Unit 2: Genetics-II	15 lectures
1.	L**inkage, Crossing over, Gene Mapping:** Study of genetic linkage; Morgan's experiment with Drosophila, Crossing over –recombination and chromosomal exchange, Concept of genetic map, mapping with two point and three point test crosses.	
2.	**Tools for genetic mapping:** Tetrad analysis and problems. Using tetrad analysis to map two linked genes, Using linear tetrad to calculate gene-centromere distance.	
Sub Unit	**Unit 3: Biostatistics**	**15 lectures**
1.	**Steps in Testing Statistical Hypothesis**: Parametric Tests: Z Test – Single Mean and Two Means, t-Test – Single Mean, Paired and Unpaired. Non-parametric Tests: Chi-Square Test. Test of proportions, Test of association, Test of goodness of fit. Calculation of chi-square value.	
2.	**Coefficient of Correlation and Regression Analysis**: Measures of relationship between continuous variables. Types of correlation. Calculation of correlation coefficient from ungrouped and grouped series. Calculation of regression coefficient. Regression line	
3.	**Comparing several means:** One-way ANOVA	
4.	**Use of computers and statistical packages**: MS Excel, BMDP and SAS.	

CA **(Continuous Assessment)**	CA1- Written test CA 2- **Problems (Unit 2 / 3)**	
References:	• Russell P. J. (2016). Essential iGenetics. 3rd Edition. Pearson Education. • Russell P. J. (1998). Genetics. 5th Edition. Benjamin/Cummings Publishing Company Inc. • Nelson D. L., and Cox M. M. (2008). Lehninger Principles of Biochemistry. 5th Edition. W H Freeman and Company. • Tropp B. E (2012). Molecular Biology - Genes to Proteins. 4th Edition. Jones & Bartlett Publishers. • Mahajan B. K. (2016). Methods in Biostatistics for Medical Students and Research Workers. Jaypee Brothers Medical Publishers (P) Ltd. • Rastogi V. B. (2019). Biostatistics. 3rd Edition. Scientific International Pvt. Ltd. • Gerstman B. B. (2008). Basic Biostatistics. Jones and Bartlett Publishers. • Norman G. R. and Streiner D. L. (2008). Biostatistics. 3rd Edition. BC Decker. • Arora P. N. and Malhan P. K. (2013). Biostatistics. 2nd Edition. Himalaya Publishing House. • Pandey M.V. (2015). Learning Biostatistics – Basic and Advanced. • Wayne W. D. and Chad L. C. (2014). Biostatistics - Basic Concepts and Methodology for the Health Sciences. 10th Edition. Wiley India Pvt. Ltd.	

SBT405	Applied Chemistry - I	3 Credits
Learning Objectives	➢ **To familiarize students with reactions of amino acids and urea cycle.** ➢ **To provide an understanding of Nanotechnology techniques** ➢ **To acquaint students with fundamentals in Nanobiotechnology used in understanding their application in different branches of biotechnology.**	
Course description	**The Bioorganic Chemistry course is designed to impart knowledge related to reactions of amino acids. These vital bioorganic compounds play indispensable functions in the cell. Hence a comprehensive understanding of metabolic fates of amino acids and proteins, will prepare students for a future career in academia, industry and research.** **This Nanochemistry course aims to help the student understand principles and applications of Nanoparticles and Nanomaterials.**	
	THEORY	**45 lectures**
Sub Unit	**Unit 1: Amino acid Reactions**	**15 lectures**
1.	**Metabolic fates of Amino group** Proteolytic enzymes and break down of dietary proteins	
2.	**Excretion of NH_2 and CO_2** Pyridoxal phosphate mediated transport of α NH_2 group to α KGA Release of NH_2 group of glutamic acid in hepatic tissue and in blood stream Oxidative Deamination and Transdeamination Alanine mediated transport of NH_2 group from skeletal muscle to liver ; Glucose- Alanine cycle Ammonia toxicity	
3.	**Urea cycle** Production of urea via **Urea cycle** Integration of Urea cycle with TCA Regulation of Urea cycle	

4.	**Amino acid degradation pathways** Degradation of amino acid to Pyruvate and Acetyl Co A Genetic diseases associated with amino acid catabolism	
Sub Unit	**Unit 2: Nanochemistry**	**15 lectures**
1.	**Introduction to Nanotechnology**: Definition, origin of nano concept, Basic and basis, Current research in nanomaterials, Bottom –up and Top- down approaches, Functional approach.	
2.	**Types of Nanoparticle, Properties and Application**: Properties and Application of – Magnetic nanoparticle, Nanoshell particle, carbon nanotube, Biologically derived nanocomposite, Quantum dots.	
3.	**Synthesis of Nanoparticle:** a)Physical methods- 1. High energy ball milling, 2. Laser Vaporization. b)Chemical methods- 1. Sol- gel method 2. Lab on chip c)Biological methods- 1. Using microorganism 2. Using Plant extract 3. Using DNA 4. Using Protein	
4.	**Analytical techniques for Characterization of Nanomaterial and General Application of Nanotechnology:** ***Techniques:*** X-ray diffraction, Dynamic light scattering, and Spectroscopic and Microscopic techniques.	

Sub Unit	Unit 3: Applications of Nanochemistry	15 lectures
1.	**Application of Nanotechnology** **Nanopharmacology and Pharmaceutical industry:** Nanopharmacology, Nano lipid drug delivery, Protein nanotechnology, Biomaterial as nanobiopharmaceuticals.	
2.	**Nanotechnology in Medicine:** Application in Bioengineering, Bionanotechnology, biomedical, Sensorineural hearing loss, Imaging and cancer therapy, Diabetes.	
3.	**Nanotechnology in Agriculture and Food industries:** Nanotechnology and food, Functional material in Food	
4.	**Nanotechnology in Environment:** Pollution prevention, Environmental sensing, catalyst, bioremediation, water and soil treatment.	
5.	**Ethics and limitations of Nanochemistry**	
CA **(Continuous Assessment)**	CA1- Written test CA 2- Presentations (Unit II/III)	
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. • Shanmugam S (2010).Nanotechnology. MJP Publishers. • Kulkarni K. Sulabha (2011). Nanotechnology; Principles and Practices. 2nd Edition. Capital Publishing Company. • Breck M.W. (2016). Nanotechnology. Volume I. CBS Publishers and Distributors Pvt. Ltd. • Breck M.W. (2016). Nanotechnology. Volume II. CBS Publishers and Distributors Pvt. Ltd.	

SBT406	Applied Chemistry-II	3 Credits
Learning Objectives	➢ **To understand the concept and usefulness of Tracer Techniques.** ➢ **To acquaint students with the concepts and applications of Polymer Chemistry** ➢ **To train the student in the principles, significance and applications of Green chemistry.**	
Course description	**The topic of tracer techniques will acquaint students with the concepts and applications of radioisotopes particularly in Biological Sciences.** **This topic will help in developing an understanding of Polymers with an emphasis on polymers used in Biosciences.** **This portion will inculcate values of green and sustainable chemistry amongst students.**	
	THEORY	**(45 lectures)**
Sub Unit	**Unit 1: Tracer Techniques**	**15 lectures**
1.	**Introduction**: Significance of radioisotope techniques. Nature of radioactivity.	
2.	**Detection and measurement of radioactivity:** Methods based upon - Gas ionisation (GM counters). Excitation of solids and solutions (Scintillation counting). Exposure to photographic emulsions (Autoradiography).	
3.	**Practical and safety aspects of counting radioactivity:** Analysis of data; Safety measures in handling tracers.	
4.	**Applications:** Tracer techniques in Biology.	

Sub Unit	Unit 2: Polymer Chemistry	15 lectures
1.	**Polymers :** Introduction to Polymers. Types of Polymers (polymer structure and physical properties) - Monomer, Polymer, Homopolymer, Copolymer, Thermoplastics and Thermosets. Addition and Condensation of Polymers (Examples and Uses) Stereochemistry of Polymers.	
2.	**Bio-based polymers:** Biodegradable plastics, developments and environmental impacts, hydro biodegradable and photo biodegradable, starch synthetic aliphatic polyester blends. Difference between standards for biodegradation, polybutylene succinate (pbs) and polybutylene.	
3.	**Synthesis, Applications and Environmental impact of Bio-based polymers:** **Synthesis** - Traditional methods (Polymers produced from classical chemical synthesis from bio based monomers); Modern methods (Recent advances in synthesis of biopolymers). **Applications** - Traditional applications (Conventional packaging materials); Modern applications (environmentally degradable synthetic biodegradable polymers as medical devices); Packaging materials (potential bio based packaging materials). **Environmental Impact** - biodegradability and compostability.	
Sub Unit	**Unit 3: Green Chemistry**	**15 lectures**
1.	**Introduction:** What is Green Chemistry? (Concept of atom economy, green method, green product, recycle waste), Definition of Green chemistry, Significance of green chemistry (sustainability and cleaner production, eco efficiency), Root of innovation, limitations.	
2.	**Tools and principles:** Tools and Principles of green chemistry	

	Examples of green material (Starting material, reaction reagent, recyclable chemical product)	
3.	**Application:** Supercritical fluid Use of biocatalyst Photo catalytic oxidation treatment for waste water. Removal of dye from industrial effluent and waste. Biological treatment by microorganism Phyto derived Nanoparticle synthesis Biopesticide and Biofertilizer.	
CA **(Continuous Assessment)**	CA1 - Written test CA2 – Assignments (Unit 2 / 3)	
References:	• Wilson K., and Walker J. (2010). Principles and Techniques of Biochemistry and Molecular Biology. 7th Edition. Cambridge University Press. • Upadhyay A., Upadhyay K. and Nath N. (2016). Biophysical Biochemistry: Principles and Techniques. Himalaya Publishing House • Ahluwalia.K.V. (2006). Green Chemistry; Environmentally Benign Reactions. Ane Books India. • Anastas. T.Paul and Warner. C. John. (1998). Green Chemistry; Theory and Practice. Oxford University Press. • Morrison R.T., Boyd R.N., and Bhatacharjee S.K. (2011). Organic Chemistry. 7th Edition. Pearson Education. • Wade L. G. and Singh M. S. (2007). Organic Chemistry. 6th Edition. Pearson Education • Solomon T.W.G. and Fryhle C.B. (2008). Organic Chemistry. 9th Edition. John Wiley & Sons. • NIIR Board of consultants and engineers. (2006). The complete book on biodegradable plastics and polymers (recent developments, properties, analysis, materials and processes). National Institute of Industrial Research. Delhi. • John McMurry. (2009). Introduction to organic chemistry. Cengage Learning India Private Limited.	

SBT407	Entrepreneurship and IPR	3 Credits
Learning Objectives	➢ **To inculcate an interest in Entrepreneurial approach to situations.** ➢ **To enable the student to understand the importance and application of IPR particularly with respect to innovations.**	
Course description	**This course will develop entrepreneurial potential with a greater understanding of its applicability and significance. Students will also understand the need and importance of Quality, QC, QA, GMP and GLP.** **This course will further impart knowledge of IPR and its applications in Biotechnology developments.**	
Sub Unit	**Unit 1: Entrepreneurship**	**15 lectures**
1.	Introduction to concept and meaning of Entrepreneurship, Need and significance of entrepreneurship Motivating factors and barriers Innovation, Creativity in entrepreneurial endeavor.	
2.	Concept of entrepreneur and Intrapreneur Qualities of a good entrepreneur Role and responsibilities of an entrepreneur	
3.	Entrepreneurship in the field of Biotechnology Indian scenario and global scenario (case study)	
Sub Unit	**Unit 2: Entrepreneurship Development and Quality**	**15 lectures**
1.	Business Planning Process Marketing Plan, Operational /Production Plan, Organizational Plan and Financial Plan.	
2.	Introduction to the concept of Quality, Quality Control, Quality Assurance, GLP and GMP; Meaning, Definition, significance.	
3.	Designing an Entrepreneurial plan for Biotechnology based product. (Probiotics, monoclonal antibodies, Diagnostic kits)	

Sub Unit	Unit 3: IPR	15 lectures
1.	Meaning and Protection of IPR Trade Secret Patent Copyright Plant Variety Protection (PVP)	
2.	Choice of IPR protection Patent laws: Paris Convention Treaty (PCT), World Intellectual Property Organization (WIPO), European Patent Convention (EPC), TRIPs, WTO, India and TRIPs	
3.	Protection of Biotechnological Inventions Patenting Genes and DNA sequences, and Life Forms IPR and developing country Broad Patents in Biotechnology	
4.	Plant Breeders Rights Management of IPR Benefits and disadvantages of IPR	
CA **(Continuous Assessment)**	CA1 – Written test CA 2 – Entrepreneurial Endeavour	
References:	• Lall M., Sahai S. (2008) Entrepreneurship. 2nd Edition.Anurag Jain for Excel Books Publication. • Hugo W. B., Russel A. D. (1998).Pharmaceutical Microbiology Sixth Edition. Replika Press Private Ltd. • Singh B. D. (2011). Biotechnology. Kalyani Publishers.	

Semester 4 Practical

SBTP401	**Molecular Immunology and Cytoskeleton, Gene Regulation and Cloning Tools, Medical Microbiology**
	1. Radial Immunodiffusion/ Mancini method. 2. Widal Test – Qualitative and Quantitative. 3. Serum Electrophoresis. 4. ELISA – demonstration (Kit based). 5. Bacterial gDNA extraction. 6. AGE of bacterial gDNA. 7. Restriction enzyme digestion. 8. Eukaryotic gene mapping. 9. Study of *S.aureus*. 10. Study of *E.coli*. 11. Study of *Salmonella*. 12. Study of *Pseudomonas*. 13. Spirochete Staining. 14. Germ tube test. 15. Microscopic detection –for malaria parasite. 16. Microscopic detection –for amoeba (Permanent Slide). 17. Chick embryo candling and inoculation methods Demonstration experiment. 18. Field trip to a research institute/ lab and report writing.
SBTP402	**Eukaryotic Genetics and Biostatistics, Applied Chemistry – I,** **Applied Chemistry - II**
	1. Replica Plate Technique 2. Gradient Plate technique 3. Transformation in *E.coli*. 4. Phage assay: Demonstration. 5. Problems in Prokaryotic Gene Mapping. 6. Study of Barr body. 7. Problems from Biostatistics – Z-test; t-test; Chi-square; Correlation coefficient; Regression analysis; ANOVA. 8. Use of MS Excel for Biostatistics. 9. Bradford / Lowry method for protein Estimation. 10. SGOT. 11. SGPT. 12. Biopolymer synthesis: Edible plastic. 13. Synthesis of metal nanoparticle and characterization by UV-Vis spectrophotometer. 14. Study the antimicrobial property of metal nanoparticle. 15. Study the biocompatibility of metal nanoparticle by using blood cells. 16. Field trip and report writing.

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/Case studies etc.

II. **Semester End Examination (SEE)** 60 Marks

[B] Evaluation scheme for Practical courses

(i) Internal Practical 60 Marks

(ii) Semester End Practical 90 Marks

[60 Marks of practical component to be assigned for research project (30M + 30 M =60)]