Shivaji University, Kolhapur

Name of Department: Biotechnology

Name of Programme: M. Sc.

Vision		
Instill ideas amongst the budding youths in the eras of Biotechnology and nurturing the human resource for national and global needs.		
Mission		
Applications of different areas of Biotechnology to develop the know how for plant, animal and medical sciences.		
Program Outcomes		
1. Two years of M.Sc. Biotechnology course in their curricula, students are getting knowledge of presentation, writing, explanation and hands on practical training so they will communicate which is important for their future. 2. They are able to design their own projects and develop their ability to work in team to solve social problems. 3. Students become sound in analytical skill and ability to correlate scientific knowledge in practice. 4. Aspirant should learn professional values by lessoning of various eminent personalities came across with them through the year.		
Program Specific Outcomes		
1. Students will get detailed knowledge of Biotechnology and its related field of Molecular Biology, Genetic Engineering, Plant and Animal Tissue Culture and Medical Biotechnology. 2. After getting the degree student will able to get job opportunities in industries as well as will able to start their own business. 3. Will become expertise in various analytical techniques and practically sound so they will be good candidate for higher studies. 4. Theoretical knowledge gained will be useful to prepare NET, SET, GATE, GRE and other competitive exams in India and Abroad.		
Course Outcomes		
Part-I Semester-I		
CC 101 A (CBCS)	Cell Biochemistry & Nucleic	1. Be able to define the structure and colligative properties of water, concept of pH, physiologically important buffer system and

	Acids	its regulation. 2. Relate to the concepts of various types of bonds, bond length, bond energy and generation and utilization of energy rich molecules like ATP. Chemical foundation of life. 3. Be able to analyze Gibbs free energy enthalpy and entropy, applications of laws of thermodynamics in living systems. 4. Describe basics of evolution of biomolecules with reference to Miller's experiment, evolution of prokaryotes and eukaryotes. 5. Describe cell biology with special reference to cell organization of prokaryotic and eukaryotic cells. Structural and functional capitalization of cell-mitochondria, chloroplast, lysozymes, Golgi bodies, plasma membrane and cytoskeleton, cell wall and nucleus, cell cycle and cell division, chromosome and genetic information storage. 6. Understand and explain details of Nucleic acid structure and metabolism.
CC 101 B (CBCS)	Cell Biology, Microbiology and Virology	1. Classify the prokaryotic and eukaryotic cell and define functions of each and every cell organelle. 2. Study the cell cycle in details. 3. Study the structure, classification and general characteristics of bacteria and viruses. 4. Study different methods in microbiology. 5. Experiment with microbial growth dynamics.
CC 102	Proteins: Structure and Functions	1. Describe general metabolism scheme of amino acids, proteins and urea cycle 2. Evaluate techniques for studying primary sequence of proteins, experimental methods, end group analysis. 3. Explain dynamics of protein folding and role of molecular chaperones. 4. Demonstrate chemical synthesis of peptides/ solid phase automated synthesis.

		5. Interpret protein evolution, convergent and divergent trees and illustrate Protein turnover 6. Describe vitamins as coenzymes and cofactors, sources, requirements, functions and deficiency symptoms of water soluble vitamins, structure and biochemical role.
CC 103	Biomolecules	1. Be able to demonstrate the structural and functional role of biomolecules essential for cellular reactions. 2. Illustrate the catalytic mechanisms involved in synthesis of chemical energy from biomolecules. 3. Explain the physiological significance of anabolic and catabolic pathways used to drive cellular functions. 4. Enlist the chemical and biological differences between DNA, RNA and their role in cellular behavior. 5. Summarize the central dogma of molecular biology and how mutations in DNA can alter cell performance.
CC 104 A (CBCS)	Basics of Physiology and Endocrinology	1. Illustrate and relate to the detailed physiology of i) Digestive system; ii) Liver; iii) Heart and iv) Kidney. 2. Understand structure and functions of brain, brain cells, CNS and peripheral nervous system. 3. Understand and elaborate on biochemistry of vision with special reference to rod and cone cells, visual cycle and regulation of colour vision. 4. Illustrate mechanism of muscle contraction through interaction between actin and myosin and role of calcium in it. 5. Classify hormones on the basis of their structure and function. 6. Detailed study of pituitary, sex, thyroide (T3 & T4) and adrenal hormones.

CC 104 B (CBCS)	Biostatistics and Computer Applications	1. Describe measures of central tendency and dispersion. 2. Apply probability and distribution. 3. Analyse bivariate data, hypothesis testing. Describebasics of computers, programming languages and application software. 4. Be able to relate to bioinformatics, databases, databank search, data mining, data management and interpretation. 5. Summarise genomics and proteomics.
Part-I Semester-II		
CC 201	Enzymology	1. Classify of enzymes and explain the structural – functional co-relation of enzymes 2. Illustrate the fundamental mechanism of enzyme activity through activation energy, binding energy and complementarity between enzyme active site and transition state 3. Detailed study of enzyme catalysis which includes factors affecting catalytic efficiency - proximity and orientation effects , distortion or strain, acid – base, nucleophilic catalysis, metal ion catalysis and covalent catalysis 4. Interpret enzyme kinetics including types of enzyme inhibitions and their role in chemical modification. 5. Analyze he structure function relations in various enzymes and basics of enzyme regulation. 6. Apply the process and commercial applications of immobilized enzymes.
CC 202	Molecular Biology	1. Explain the structure and organization of genome in the cell. 2. Illustrate characterization of DNA using different techniques. 3. Explain various types of Mutation. 4. Compare and contrast the basic DNA replication/ DNA recombination/ DNA repair process. 5. Illustrate basics of transcription process and

		transcription regulations. 6. Describe the process of Protein Synthesis and protein transport.
CC 203	Bioenergetics	1. Demonstrate the metabolic processes through which the energy is produced and utilized. 2. Get knowledge of redox couples and redox potentials. 3. Compare oxidative phosphorylation and photophosphorylation at molecular level. 4. Elucidate the inhibition of electron transport chain by various inhibitors. 5. Be able to study chemical nature of different hormones, how they influence biomolecular and cellular functions. 6. Illustrate the process of nitrogen fixation.
CC 204	Tools and Techniques in Biosciences	1. Illustrate the general scheme for purification of bio-components. 2. Describe different methods utilized for isolation of different cell organelles, subcellular fractions and marker enzymes. 3. Demonstrate various chromatography techniques: ion-exchange, gel filtration, partition, affinity, HPLC and reverse phase chromatography, gas chromatography, TLC, Paper chromatography, Chromatofocussing. 4. Study of centrifugation technique: Ultracentrifugation - density gradient centrifugation and molecular weight determination. 5. Describe electrophoresis with respect to basic techniques, poly acrylamide/ starch/ agarose gel electrophoresis, use of SDS/urea, isoelectric focusing, capillary electrophoresis. Pulse field gel electrophoresis. 6. Describe principles and applications of tracer techniques in biology, measurement of alpha, beta and gamma radiations, radiation dosimetry, radioactive isotopes and half life of isotopes, autoradiography, cerenkov

		radiation, liquid scintillation spectrometry. 7. Experiment with study of X-ray diffraction, fluorescence, UV, visible, CD/ORD, ESR, NMR and Mass spectroscopy, atomic absorption spectroscopy, plasma emission spectroscopy and microscopy.
Part-II Semester-III		
GE 341	Genetic Engineering	1. Explain the function of restriction endonucleases. 2. Analyze the importance of plasmids and viruses in genetic engineering. 3. Be able to apply the techniques of selection and screening of clones. 4. Explain how to construct the DNA libraries and how to screen for clones that contain a desired gene fragment. 5. Describe the process polymerase chain reaction (PCR) and demonstrate its application. 6. Illustrate the applications of recombinant DNA technology.
IC 341	Immuno-chemistry	1. Classify fundamentals and anatomy of immune system. 2. Have clarity about innate immune system, physiological anatomical and cellular components of innate mechanisms – complement fixation, phagocytosis and toll like receptors. 3. Be able to explain genetic basis of antibody structure and generation of antibody diversity. 4. Demonstrate the role of MHC I and MHC II in antigen presentation and the concept of MHC polymorphism 5. CO5: Imbibe the concept of B and T cell maturation and activation and generation of cytokines. 6. Explain the basis of hypersensitivity, immune

		deficiency and autoimmune diseases. 7. Be able to apply the principles of immunological techniques, viz. immunoprecipitation, immune-electrophoresis, ELISA, RIA, FACS, Western blot, Hybridoma technology, generation and applications of monoclonal antibodies.
BT 341	Plant Biotechnology	1. Adapt and apply PTC techniques to resolve problems in plant biology. 2. Be able to prepare culture medium and establish in vitro plant cultures from primary and secondary explants. 3. Perform the observations and biometric and physiological measurements with techniques used in the laboratory. 4. Able to work independently in plant tissue culture laboratory. 5. Get knowledge on setting-up and operating a plant tissue culture laboratory. 6. Get prepared for immediate employment in the plant tissue culture industry. 7. Understand the scientific writing skills appropriate for the field of plant tissue culture.
FT 341	Fermentation Technology II	1. Be able to demonstrate microbial cell growth, kinetics and Strain improvement by mutation, overproduction of metabolites 2. Describe development of innocula and production media for industrial fermentation. 3. Utilize the process and instrumentation involved in fermentation operations including computer controlled operations. 4. Apply the process of batch, fed-batch and continuous fermentation, scale up and scale down of processes, types of fermenters and economics involved in the process. 5. Detailed description of down-stream processing: isolation and purification of various metabolites from fermented media.

Part-II semester-IV		
AT 441	Animal Tissue Culture	1. Acquire basics of mammalian cell culture techniques 2. Perform establishment of cell lines and their maintenance 3. Demonstrate knowledge on design and use the cell culture facilities 4. Evaluate cell cultures constraints and possibilities as an in vitro model 5. Handle cultures of mammalian cells with good viability, minimal contamination and appropriate documentation. 6. Perform supportive tasks relevant to cell culture such as cryopreservation and recovery. 7. Recognize and troubleshoot problems common to routine cell culture.
AGP 441	Advances in Genomics and Proteomics	1. Recent advances in genomics, transcriptomics, metabolomics and proteomics. 2. Advanced genomics technologies and their applications to study gene function. 3. Obtaining and analyzing data relating to specific genes using number of databases, bioinformatics principles and tools. 4. Evaluation of current scientific literature and important findings of research. 5. Range of practical techniques including DNA sequencing, PCR and proteomics. 6. Understanding the principles and analysis using Mass Spectroscopy including HPLC and LCQTOFMS, applications of other analytical techniques such as SPR, 2-D gel electrophoresis etc.
BI 441	Bioinformatics	1. Classify protein sequence information, composition and properties and describe types of sequence alignments, gap-penalties, scoring matrices. 2. Illustrate various BLAST programmes and their uses. 3. Describe homology modeling, prediction of

		protein structure from sequences. 4. Explain Human Genome project, approaches to gene identification using structural biology, molecular modeling methods. 5. Describe molecular docking, molecular dynamics simulations, phylogenetic analysis and software. 6. Describe concept of microarrays, techniques and applications of microarray technology.
APB 441	Advances in Plant Biotechnology	1. Develop fundamental knowledge in Plant Molecular Biotechnology and its application in laboratory and industry settings. 2. Explain the basics of the physiological and molecular processes that occur during plant growth and development and during environmental adaptations. 3. Understand how biotechnology has been used to develop knowledge of complex processes that occur in the plant 4. Understand the processes involved in the planning and execution of plant biotechnology experiments 5. Explain how biotechnology is used for plant improvement and discuss the ethical implications of that use 6. Critically evaluate scientific data and develop research proposals to address identified gaps.

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Mission		
Applications of different areas of Biotechnology to develop the know how for plant, animal and medical sciences.		
Course Outcomes		
Compulsory Courses		
Paper I	Research Methodology	1. Describe basics of computers, programming languages and application software. 2. Be able to use different presentation tools and relate to bioinformatics, databases, databank search, data mining, data management and interpretation. 3. Describe measures of central tendency and dispersion. 4. Apply probability and distribution along with analysis of bivariate data, hypothesis testing. 5. Detailed insights into research by understanding i) definitions and kinds of scientific documents; ii) IMRAD system; iii) communications with the publishers; iv) Oral and poster presentation at conferences and v) preparation and submission of research projects for funding. 6. Understand identification and characterization of DNA, RNA and Plasmids. 7. Illustrate and elaborate various techniques involved in molecular biology research viz. RAPD, RFLP, DGGE, TGGE, PCR etc. 8. Learn and understand various analytical

		techniques associated with biological research.
Paper II	Recent Trends in Biological Sciences	1. Explain the function of restriction endonucleases. 2. Analyze the importance of plasmids and viruses in genetic engineering. 3. Explain how to construct the DNA libraries and how to screen for clones that contain a desired gene fragment. 4. Illustrate the applications of recombinant DNA technology. 5. Be able to explain genetic basis of antibody structure and generation of antibody diversity. 6. Demonstrate the role of MHC I and MHC II in antigen presentation and the concept of MHC polymorphism. 7. Be able to apply the principles of immunological techniques, viz. immunoprecipitation, immunoelectrophoresis, ELISA, RIA, FACS, Western blot, Hybridoma technology, generation and applications of monoclonal antibodies. 8. Be able to demonstrate techniques involved in plant and animal cell and tissue culture: Techniques involved and industrial and clinical applications of PTC and ATC. 9. Understand the commercial utilization of biofertilizers and biosensors.
Optional Courses (Opt for any one)		
Paper III A	Bioinformatics	1. Describe primary, secondary sequence databases, structural databases and types of sequence alignments including scoring matrices. 2. Explain various applications of BLAST and phylogenetic analysis methods. 3. Be able to understand ribose ring conformations and structural biology of

		biomolecules. 4. Describe techniques and applications of microarray technology along with gene identification methods 5. Demonstrate molecular modelling and protein structure prediction methods.
Paper III B	Bioremediation and Waste Water Treatment Technologies	1. Explain constraints and priorities of bioremediation, biotransformation and biodegradation. 2. Analyze microbial interactions with organic and inorganic pollutants. 3. Explain methods (biological and chemical) of water pollution monitoring. 4. Elaborate on different waste water treatment systems. 5. Understand applications of Bioremediation, bioaugmentation and biostimulation. 6. Explain the role of biofilms in waste water treatment. 7. Elaborate reactor types and designs utilized in bioremediation and waste water treatment.
Paper III C	Advanced Techniques in Cell Culture	1. Explain basic techniques in plant and animal tissue culture. 2. Understand plant transformation techniques and its applications. 3. Illustrate plant secondary metabolites and their potential utilization in pharmaceutical industry. 4. Elaborate on animal tissue engineering with special reference to surgical manipulations. 5. Understand capillary culture units and feeder layers. 6. Study different application of animal cell culture in mutant cell preparation, karyotyping and cytogenetic characterization, production of therapeutic proteins/products etc.

Paper III D	Agricultural Microbiology and Microbial Ecology	1. Capacity to understand Soil Enzymes, Microbial Biofertilisers. Helps to introduce recent advances in biological Nitrogen fixation. 2. Understanding of plant microbe interaction for the elaboration of epidemiology of plant diseases and their biological control. 3. Acquiring concepts of new directions and importance of microbial ecology. 4. Ability to understand microbiology of the extreme environment such as hot springs, acid springs, lakes, Saline habitats, cold temperature habitat and microroenvironments having high pressure. 5. Capacity to assess correlation of anaerobic microorganisms and Geomicrobiological processes. Determination of the worth of microorganism in environmental sustainability and biotechnology.
Paper III E	Applied and Environmental Microbiology	1. Good for understanding microbial fermentation. Students were able to design different types of fermentative protocols for the production of different microbial products. 2. Elucidation of steroid transformation by microbial activity can be easily understood. 3. Describe productions of flavours, fragrance, pheromones and alkaloids by using different microbial resources and experimental protocols. Implementation of advance fermentation option such as flux control analysis etc. 4. Acquiring knowledge of different dairy microbiology fermentation protocols and standard systems 5. Describe recent advances in Microbiological waste treatment methods
Paper III F	Immunology and Medical	1. Understand regulation of immune response 2. Understand the role in vaccine in

	Microbiology	prevention of infectious diseases 3. Capacity to assess recent development in monoclonal antibody technology 4. Able to explain the pathophysiology of infectious diseases 5. Be able to apply rapid detection method of food borne pathogen
Paper III G	Fermentation Technology	1. Be able to demonstrate microbial cell growth, kinetics and Strain improvement by mutation, overproduction of metabolites. 2. Utilize the process and instrumentation involved in fermentation operations including computer controlled operations. 3. Gain the knowledge of fermentation processes involved in pharmaceutical biotechnology ethanoloc beverages; organic acids; Amino acids, Extracellular enzymes, Vitamins, Extracellular polysaccharides and Antibiotics 4. Discuss Intellectual Property Rights: Patent : Criteria for patentability, Indian patent act, Role of patent in R & D.
Paper III H	Clinical Biochemistry	1. Demonstrate the use of enzymes in the process of diagnosis and monitoring of myocardial infarction, liver and pancreatic diseases diseases. 2. Acquire the detailed current and advanced knowledge lipid profile and its significance. 3. Express the physiological significance of Blood groups, Rh factor blood transfusion. Hemoglobinopathies: cell anemia. 4. Describe various types of Biochemical and other techniques used in clinical chemistry ELISA, RIA, IRMA and Noninvasive techniques used in clinical practice, sonography, X-ray, MRI, CT Scan. 5. Interpret the chemical carcinogenesis and tumor staging at molecular basis. 6. Demonstrate the genetic basis of AIDS,

		SARS, and Dengue.