Shivaji University, Kolhapur

Name of Department: Biochemistry

Name of Programme: M. Sc.

Vision
Craft a Competent human resource for research in Clinical Biochemistry and Bioinformatics.
Mission
Nurture the department to be a center of excellence in the new era of Biochemical Sciences by grooming youth at par with global competence.
Program Outcomes
1. Students should have gain knowledge in fundamental concepts Biochemistry. The graduate should also get sufficient knowledge of the applied subjects like Genetic Engineering, Fermentation Technology, Tools and Techniques in Biosciences, Bioinformatics etc. 2. Student should become well versed with the qualitative and quantitative evaluation of various biomolecules, enzyme assays, isolation, purification and characterization of biologically important proteins along with various techniques like PCR, gene cloning and transformation used in the field of Molecular Biology and Clinical Biochemistry. He/she also should be able to utilize the knowledge of bioinformatics in the field of protein structure prediction and molecular modeling. 3. Candidate should gain capability of handling independent research projects through planning and successful execution of the experiment and be able to analyze of the data obtained using modern technological tools and should inculcate lifelong learning to keep up with advances in the subject.
Program Specific Outcomes
1. Produce a manpower having fundamental knowledge of Biochemistry and its applications in the field of i) Enzymology; ii) Molecular Biology; iii) Tool and Techniques in Biosciences; iv) Clinical Biochemistry; v) Immunology; vi) Fermentation Technology, Biomembranes and Neurochemistry. 2. Development of confident human resource capable taking up the jobs in academics and teaching, corporate organizations like industries, contract

research organizations etc. in the fields like pharmaceuticals, cosmetics, food, forensic sciences and molecular biology etc.

3. Developing a candidate with a confidence of being successful in various competitive examinations like NET, SET, GATE, GRE, TOFEL etc. and proceed for a research career. Groom and encourage the students to be entrepreneur in life sciences products having applications in the area of food, health, cosmetics, agriculture etc. and be able to solve regional problems.

Course Outcomes

Part-I Semester-I

CC 101 A (CBCS)	Cell Biochemistry & Nucleic Acids	1. Be able to define the structure and colligative properties of water, concept of pH, physiologically important buffer system and 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 functionalrole of biomoleculesessential 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 differencesbetween 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.
BC 341	Biomembranes and	1. Classify the structure of biomembranes illustrate the significance of and fluid

	Cytoskeleton	mosaic model. 2. Describe basics of Protein targeting. 3. Be able to relate to transport of various biomolecules across biomembrane, and concept of active passive, facilitated and receptor mediated endocytosis. 4. Classify cellular cytoskeleton, Interplay of microtubule, micro filaments and intermediary filaments. 5. Demonstrate cell signaling, Details of G protein family, adenyl cyclase, cAMP, cGMP, CRE and CREB proteins.
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		
RME 441	Research Methodology, Entrepreneurship Development and Tissue Culture	1. Demonstrate the basic concept of research, types of research – basic, novel and applied research. 2. Be able to formulate research hypothesis, steps in research design, research aptitude, qualities of a researcher and ethics in research – plagiarism. 3. Apply the knowledge intellectual property rights in obtaining copyright, trademark, patent.

		4. Be able to relate to the concept of entrepreneurship development: Small Enterprises, Project Formulation, market survey and research, techno economic feasibility assessment, preparation of preliminary project reports, Government policy for small scale enterprises expansion and diversification. 5. Demonstrate good communication skills and be able to frame business letters; technical report writing, minutes of meetings, CV and interview skills. 6. Develop detailed concept of Good Manufacturing Practice: Quality assurance, quality management, Quality control and guidelines for microbial and animal cell cultivation and animal usage. 7. 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.
NC 441	Neurochemistry and Carcinogenesis	1. Demonstrate organization of human nervous system, chemical composition of brain and blood – Brain barrier. 2. Be able to relate the process of Neurotransmission process and mechanism of axonal neurotransmission. Types of channels 3. Describe the concept of neurotransmitters, cholinergic receptors, Agonists and Antagonists and their mode of action and effects. 4. Describe mechanism of Learning and memory: Long Term Potentiation, NMDA and AMPA, retrograde messengers in synaptic transmission, concept of synaptic plasticity. 5. Be able to demonstrate molecular basis of Parkinson's disease, Alzheimer's disease,

		Schizophrenia, Myasthenia gravis and Multiple sclerosis. 6. Be able to interpret the role of chemical carcinogens in mutagenesis and molecular mechanism involved in cancer development. 7. Summarize different classes and mechanisms of oncogenes and outline changes in cell behavior on transformation
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 programs 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.
FT 441	Fermentation Technology II	1. Be able to demonstrate basics of industrial applications of fermentation technology. 2. Gain the knowledge of fermentation processes involved in pharmaceutical biotechnology ethanolic beverages; organic acids; Amino acids, Extracellular enzymes, Vitamins, Extracellular polysaccharides and Antibiotics 3. Study of the processes involved in production of therapeutic proteins. 4. Describe production of industrially

		important secondary plant metabolites, bioinsecticides, bioplastics, biogas etc. 5. Apply the role of bioremediation in petroleum industry, Bioleaching / Biomining, Biotechnological applications of extremophiles, Waste treatment, Microbial desulphurisation of coal. 6. Discuss Intellectual Property Rights: Patent : Criteria for patentability, Indian patent act, Role of patent in R & D.

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Mission		
Nurture the department to be a center of excellence in the new era of Biochemical Sciences by grooming youth at par with global competence.		
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	6. Good for understanding microbial fermentation. Students were able to design different types of fermentative protocols for the production of different microbial products. 7. Elucidation of steroid transformation by microbial activity can be easily understood. 8. 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. 9. Acquiring knowledge of different dairy microbiology fermentation protocols and standard systems. 10. Describe recent advances in Microbiological waste treatment methods.

Paper III F	Immunology and Medical Microbiology	1. Understand regulation of immune response. 2. Understand the role in vaccine in 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 ethanolic 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.