Shivaji University, Kolhapur

Name of Department: Biochemistry

Name of Programme: M. Sc. in Biochemistry

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 biologicaldifferencesbetween DNA, RNA and theirrole 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.
LC BC 141	Laboratory Course I	1. Student will able to understand applications of various laboratory instruments like – pH meter, colorimeter, single pan balance, centrifuge etc. 2. Capable to carry out quantitative estimation of proteins. 3. Capable to carry out quantitative estimation of carbohydrates. 4. Capable to carry out quantitative estimation of lipids.

		5. Capable to carry out quantitative estimation of nucleic acids.
LC BC 142	Laboratory Course II	1. Able to demonstrate isolation of proteins from various sources. 2. Able to demonstrate isolation of polysaccharides from various sources. 3. Able to demonstrate isolation of cholesterol and lecithin from egg. 4. Capable to check quality of oil using various quantitative methods. 5. Capable to detect amino acids.
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.
LC BC 241	Laboratory Course III	1. Student will be able to understand various chromatographic techniques. 2. Able to demonstrate separations of proteins using electrophoresis technique. 3. Capable to immobilize enzymes for various applications. 4. Able to demonstrate separations of proteins using molecular sieve chromatography. 5. Able to isolate and characterize glycogen from liver.
LC BC 242	Laboratory Course IV	1. Capable to carry out enzyme activity of various enzymes such as amylase, invertase, amyloglucosidase, alkaline phosphatase etc. 2. Able to determine specific activity of enzyme 3. Be able to analyze enzyme kinetics of various enzymes. 4. Capable to isolate different enzymes from various sources. 5. Capable to co-relate different parameters for application of enzymes.

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 Cytoskeleton	1. Classify the structure of biomembranes illustrate the significance of and fluid 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 I	1. Be able to demonstratemicrobial 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.
LC BC 345	Laboratory Course V	1. Be able to isolate and characterize biopolymers from animal/tissues or organs. 2. To learn estimation and quantification of vitamins using microbial assay. 3. Be able to perform colorimetric estimation of sugars and minerals. 4. To study the inductive enzymes of microbial origin.
LC BC 346	Laboratory Course VI	1. Be able to isolate and characterize biological pigments from plant sources. 2. Learn the chromatographic techniques for the separation of biomolecules. 3. Use of biophysical/biochemical techniques for the separation of metabolic products. 4. Be able to understand and perform various antibiotic sensitivity assays. 5. Be able to perform various immunological techniques.
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 controland 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. Beable 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 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.
FT 441	Fermentation Technology II	1. Be able to demonstrate basics ofindustrial applications of fermentation technology. 2. Gain the knowledge of fermentation processes involved in pharmaceutical biotechnology ethanoloc 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, Microbialdesulphurisation of coal. 6. Discuss Intellectual Property Rights: Patent : Criteria for patentability, Indian patent act,

		Role of patent in R & D.
LC BC 405	Laboratory Course VII	1. Be able to learn and perform various biophysical techniques. 2. Understand various techniques involved in the experimentation related to Molecular Biology. 3. Be able to perform estimation of various biological excretory metabolites. 4. In vitro understanding of biological function of organs like small intestine. 5. Understand and perform preliminary experiments in plant tissue culture.
LC BC 406	Laboratory Course VIII	1. Understand and perform experiments in Clinical biochemistry. 2. Be able to perform various immunobiochemical techniques. 3. Learning of the commercial software related to biopolymer structures. 4. Be to understand application of bioinformatics related to molecular docking studies and drug discovery. 5. Be able to undertake independent research problem and draw meaningful conclusion.