



PROGRAMME STRUCTURE
M.Sc. Biochemistry Semester: III

Programme Outcome (PO) - For M.Sc. Biochemistry Programme	<ol style="list-style-type: none"> Biochemistry masters students will be able to comprehend fundamental Biochemistry principles underlying normal physiology and pathogenesis. They will develop proficiency in Biochemistry Laboratory experiments as well as theory. They will be able to translate their knowledge with a skilful job at various industries and research labs. The students will become employable in the fields of Quality Assurance, Production, Research and Teaching in Biopharmaceuticals, Nutraceuticals, Dairy, Agriculture, Environment, Clinical, Biotechnology and Life sciences.
Programme Specific Outcome (PSO) - For MSc Biochemistry Semester - III	<ol style="list-style-type: none"> The students will learn principles of important instruments useful in Biochemistry experiments. The Biochemistry students will further develop their proficiency in Biochemistry Laboratory experiments as well as theory. They will be able to design and carry out standard Biochemistry experiments on their own.

To Pass	<ol style="list-style-type: none"> At least 40% marks in each paper at the University Examination and 40% aggregate marks in Internal and External Assessment. At least 33% Marks in each paper in Internal Assessment.
---------	---

Course Type	Course Code	Name Of Course	Theory/ Practical	Credit	Exam Duration in hrs	Component of Marks		
						Internal	External	Total
						Total	Total	Total
Core Course	PS03CBIC51	Clinical Physiology	T	4	3	30	70	100
	PS03CBIC52	Genetic Engineering	T	4	3	30	70	100
	PS03CBIC53	Toxicology	T	4	3	30	70	100
	PS03CBIC54	Practicals	P	4	3	30	70	100
	PS03CBIC55	Practicals	P	4	3	30	70	100
Elective Course (Any One)	PS03EBIC51	Biomanufacturing principles and practices	T	4	3	30	70	100
	PS02EBIC52	Plant Biochemistry	T	4	3	30	70	100
	PS02EBIC53	Bioinformatics	T	4	3	30	70	100





(Master of Science) (Biochemistry)
(M.Sc.) (Biochemistry) Semester (III)

Course Code	PS03CBIC51	Title of the Course	Clinical Physiology
Total Credits of the Course	04	Hours per Week	03

Course Objectives:	Student should be able to: i. Correlate various systems of the human body with homeostasis. ii. Understand pathophysiological conditions occurring in humans.
--------------------	---

Course Content		
Unit	Description	Weightage* (%)
1.	Homeostasis and the organization of body fluids, Control of Homeostasis, Positive and negative Feedback systems, Homeostatic Imbalances. An overview of human circulatory system. Disorders of circulatory system: respiratory acidosis and alkalosis, metabolic acidosis and alkalosis, Hypoxia, coagulation disorders, hypertension, thalassaemias and anemias.	25
2.	An overview of digestive system. Hormonal and neural regulation of GIT, Gastritis, GIT obstruction, ulcers An overview of Muscular System. Disorders of muscular system: Myasthenia Gravis, muscular dystrophy, fibromyalgia, muscular atrophy and hypertrophy, Rigor Mortis.	25
3.	An overview of Nervous System. Disorders of nervous system: multiple sclerosis, epilepsy, neuropathy, Guillain-Barre syndrome. Neurotoxicity: neurotoxins, anaesthetics, neuro-transmission inhibitors. An overview of Respiratory System. Disorders of respiratory system: Asthama, Chronic Obstructive Pulmonary Disease, Cystic fibrosis, Penumonia, Pulmonary edema.	25
4.	An overview of human urinary system. Role of kidney in body water, electrolyte and acid-base balance. Renal malfunctions and hemodialysis. Nephrotic syndrome, Kidney stone, UTI Disorders of reproductive systems: prostate disorders, cryptorchidism and hernias, PMS, PMDD. Birth control: Physiology of birth control methods.	25





Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.
-------------------------------	---

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Students should be able to read and understand diagnostic reports.
2.	Student should be able to understand, how to maintain health

Suggested References:	
Sr. No.	References
1.	Hall, J. E., & Guyton, A. C. (2016) Textbook of medical physiology (13 th Edn.). Elsevier, Philadelphia.
2.	Barrett, K. E., & Ganong, W. F. (2019). Ganong's review of medical physiology (26 th Edn.) McGraw-Hill Medical, New York.
3.	Tortora, G. J., & Grabowski, S. R. (2017). Principles of Anatomy and Physiology (15 th Edn). HarperCollins College, New York.

On-line resources to be used if available as reference material





On-line Resources





(Master of Science) (Biochemistry)
(M.Sc.) (Biochemistry) Semester (III)

Course Code	PS03CBIC52	Title of the Course	GENETIC ENGINEERING
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	<ol style="list-style-type: none">1 To understand the basic tools and techniques used for manipulation of DNA2. To become familiar with the strategies for production of transgenic organisms2. To learn applications of genetic engineering in agriculture, industry and medicine
--------------------	--

Course Content		
Unit	Description	Weightage* (%)
1.	Concept and importance of Genetic Engineering; General strategies and Steps involved in gene cloning: Extraction and purification of DNA and RNA from bacteria, virus, plant and animal cells; physical and enzymatic methods for cutting DNA; Introduction of DNA into host cells; screening and selection methods for recombinant clones.	25%
2.	Basic properties and cloning strategies for vectors derived from Plasmids, bacteriophages and their chimeric vectors, YAC, BAC, HAC/MAC and viral vectors for Plant and animal cells. Salient features of expression vectors for heterologous expression in <i>E. coli</i> , Yeast, insect and mammalian system. Shuttle vectors and gene trapping vectors. Vector design and modification strategies; chemical synthesis of oligonucleotides.	25%
3.	DNA sequencing and sequence assembly: Maxam-Gilbert's and Sanger's methods, Shot gun sequencing, Next generation sequencing strategies for large genomes. DNA mapping and DNA fingerprinting: Physical and molecular mapping, Hybridization and PCR based methods of fingerprinting. Site directed mutagenesis: Methods and applications. Polymerase Chain Reaction: Principle and basic types of PCR; Reverse Transcription and Real Time PCRs. Construction genomic and cDNA libraries;	25%
4.	Applications of Genetic engineering in improvement of plants, animals	25%





	and microbes; Gene editing and its applications; Metagenomics and Metabolic engineering; Gene therapy; Restriction and regulations for the release of GMOs; Biosafety and levels of Physical and Biological containment; The Indian Guidelines for release and use of GM organisms.	
--	---	--

Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.
-------------------------------	---

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Students will learn about the basic tools to work with DNA and general methods for cloning DNA sequences (structural gene sequences and DNA).
2.	The student will acquire knowledge on advanced strategies of genetic engineering to make biotech products. Selection of vectors, cloning strategies, optimization of sequences, mutagenesis and expression of DNA sequences
3.	Apart from this, students will also become familiar with the norms for production and release of GMOs.
...	





Suggested References:

Sr. No.	References
1.	Principles of Gene Manipulation and Genomics” by Sandy B Primrose and Richard Twyman
2.	Genetic Engineering by Smita Rastogi and Neelam Pathak
3.	Gene cloning: An introduction. T. A. Brown

On-line resources to be used if available as reference material

On-line Resources





(Master of Science) (Biochemistry)
(M.Sc.) (Biochemistry) Semester (III)

Course Code	PS03CBIC53	Title of the Course	Toxicology
Total Credits of the Course	04	Hours per Week	03

Course Objectives:	<ol style="list-style-type: none">i. To learn about the dose-response relationships and understand the toxicity of various substancesii. To comprehend the knowledge of absorption, distribution, metabolism and elimination of xenobioticsiii. To provide an overview on legislative measures in the field of food, drugs and environmental toxicants
--------------------	--

Course Content		
Unit	Description	Weightage* (%)
1.	Definition and scope of toxicology: Eco-toxicology and its environmental significance, Biochemical Aspects of Toxicology Toxic effects: Basic for general classification & nature. Measurement of Dose-Response Relationships, Synergism and Antagonism Acute and Chronic exposures, Factors influencing Toxicity. Pharmacodynamics & Chemodynamics, dose conversion between animals and human Diagnosis of toxic changes in liver and kidneys: Metabolism of drugs: paracetamol and aspirin with their toxic effects on tissues.	25
2.	Xenobiotics Metabolism: Absorption & distribution. Phase I reactions. Oxidation, Reduction, Hydrolysis and Hydration. Phase II reaction/Conjugation: Methylation, Glutathione and amino acid conjugation. Detoxification. Biochemical basis of toxicity: Metabolism of Toxicity: Disturbances of Excitable membrane function. Altered calcium Homeostasis. Covalent binding of cellular macromolecules & Genotoxicity. Tissue specificity of Toxicity. Toxicity testing: Models for toxicity testing; Acute and Chronic toxicology testing, Experimental design; Genetic toxicity testing & Mutagenesis assays In vitro Test systems – Bacterial Mutation Test, Ames test, <i>In vivo</i> Mammalian Mutation tests –DNA repair assays, Chromosome damage test, Evaluation of Apoptosis and necrosis	25
3.	Pesticides: Insecticides: Organochlorines, Anti cholinesterases- Organophosphates and Carbamates, Fungicides: Captan, Di-thio carbamates, Herbicides: 2,4 D, Atrazine; Food additives: Preservatives,	25





	Processing aids, Flavor and taste modifiers, Nutritional additives; Role of diet in cardio-vascular disease and cancer. Toxicology of food additives; Metal Toxicity: Toxicology of Arsenic, mercury, lead and cadmium.	
4.	Regulatory Toxicology: Rules and regulations of Nuclear Regulatory Commission (NRC); Environmental Protection Agency (EPA); Food and Drug Administration (FDA); Drug Enforcement Administration (DEA); Occupational Safety and Health Assessment (OSHA); Committee for Purpose of Control and supervision of experimental on animals (CPCSEA)	25

Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.
-------------------------------	---

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learn the toxicity testing methods and designing of animal experimentations in pharmaceutical and drug industries or research organizations
2.	Correlate concentrations of doses, duration of exposure and animal responses

Suggested References:





Sr. No.	References
1.	Klaassen, C., D., (Ed) (2013). Casarett and Doull's toxicology : the basic science of poisons. McGraw-Hill Education, New York.
2.	Timbrell, J. A., (2008). Principles of biochemical toxicology. Taylor and Francis Ltd., London.
3.	Smart, R. C., Hodgson, E., (Ed.) (2013). Molecular and biochemical toxicology. John Wiley and Sons, Inc.

On-line resources to be used if available as reference material

On-line Resources





Course Code	PS03CBIC54	Title of the Course	LAB-I
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	<ol style="list-style-type: none">1. To learn to determine concentration of blood parameters like glucose, lipid parameters, etc.2. To learn fundamental Molecular Biology techniques like isolation of DNA, RNA, Restriction digestion, agarose gel electrophoresis of DNA, etc.3. To learn PCR.4. To learn RAPD analysis and construction of Phylogenetic tree..
--------------------	---

PS03CBIC54 (Lab 1)

1. Determination of serum glucose by GOD/POD method
2. Estimation of total cholesterol, HDL, LDL
3. Demonstration of blood pressure using digital and conventional methods
4. Observation of anatomy slides
5. Comparison of bleeding and clotting time in male and female
6. Determination of Salivary Amylase activity
7. Oxygen saturation measurement using pulse oximeter
8. Measurement of muscle strength
9. Lung capacity measurement using spirometer
10. Isolation of plasmid by alkali lysis method
11. Separation of nucleic acid by Agarose gel electro phoresis
12. Polymerase Chain Reaction
13. Transformation of *E. coli* by suitable plasmid
14. Primer designing for PCR
15. RAPD and phylogenetic tree construction

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%





Course Outcomes: Having completed this course, the learner will be able to

1.	Work with clinical samples and carry out analysis.
2.	Carry out molecular analysis of DNA and RNA.
3	Do gene cloning.

References:

1	Thimmaiah S. K. (2012). Standad Methods of Biochemical Analysis. Kalyani Publishes, New Delhi, India.
---	---





Course Code	PS03CBIC55	Title of the Course	LAB-II
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	<ol style="list-style-type: none">1. To learn to determine enzyme inhibition activity.2. To learn importance of glutathione in maintaining reducing environment in a cell and estimate glutathione as well as ROS levels.3. To learn carry out DNA integrity study.
--------------------	---

PS03CBIC55 (Lab 2)

1. Trypsin inhibitory activity
2. Effect of toxin on tissue protein levels
3. Estimation of glutathione
4. Estimation of reactive oxygen species
5. Effect of ROS on integrity of DNA by agarose gel electrophoresis
6. Micronuclei test
7. Water analysis: TSS, TDS, Alkalinity, Chlorinity.

PS03CBIC54 (Lab 2 B)

Practicals related to elective papers.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Design experiments for toxicity testing.
2.	Carry out molecular analysis of effects of toxic substances on cellular biomolecules.

References:

1	Thimmaiah S. K. (2012). Standad Methods of Biochemical Analysis. Kalyani Publishes, New Delhi, India.
---	---





(Master of Science) (Biochemistry)
(M.Sc.) (Biochemistry) Semester (III)

Course Code	PS03EBIC51	Title of the Course	Biomanufacturing principles and practices
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	<ol style="list-style-type: none">1.To make the students understand the concept, development and use of SOPs in Biomanufacturing2. To impart knowledge on essential quality parameters and their measurement in Biomanufacturing.3. Familiarize the students to the basic needs of a Biotechnology industry
--------------------	---

Course Content		
Unit	Description	Weightage* (%)
1.	Overview and design of biomanufacturing, quality by design approach, technical considerations, phases and scale up: life cycle of manufacturing, raw material considerations, compliance and quality in biomanufacturing, lean biomanufacturing; Standard manufacturing operating procedures of biotechnology, quality control of protein production, and final fill and finish of product; Case studies to be included at least: therapeutic proteins, monoclonal antibodies, human vaccines.	25%
2.	Introduction to quality system, main elements of a quality system; Essential of quality system; Practical implementation of a quality system; Structure of quality manual, correlation between GMP requirements (WHO) and ISO 9001:2000.	20%
3.	<p>Personnel: Principles of human resource management, duties of senior management, organizational structures, qualification and profiles requirement.</p> <p>Premises: Official requirements, material & personnel flow and layout, air cleanliness classes and grades, construction elements, barrier systems, isolators and safety cabinets, building services, heating ventilation air conditioning (HVAC), process gases, qualification of premises and HVAC systems, pharma monitoring of HVAC systems, particle monitoring.;</p> <p>Process Validation: Official requirements, Validation - a key element of quality management, validation planning and procedure, validation documentation, process validation and product lifecycle ; Cleaning</p>	30%





	Validation: Official requirements, how to validate cleaning procedures.	
4.	<p>Production: Sanitation, GMP in production process, sterilisation processes, aseptic processing, freeze-drying, testing for sterility, testing for endotoxins, testing for leakage and for particles, microbiological monitoring, packaging materials, packaging process.</p> <p>Information: National bodies and pharmaceutical associations; Pharmacopeia; EU directives and guidelines, USA: CFR and FDA guidelines, ICH-guidelines, PIC/S guidelines, GMP of other regions, WHO guidelines.</p>	25%

Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.
-------------------------------	---

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand fundamental operations, procedures and rules of Industrial manufacturing with special reference to Biological products.
2.	Learn the basic components of an industry, GMP and SOP along with industry standards of testing, sterilization and packing





3.	Become familiar with industry certification process, it's significance and relevance
4.	Learn various guidelines and regulations for biomanufacturing in detail

Suggested References:

Sr. No.	References
1.	Introduction to Biomanufacturing, by Northeast Biomanufacturing Center and collaboration, 2012.
2.	Introduction to Biomanufacturing, by Mark Witcher. In Encyclopedia of Industrial Biotechnology.
...	Good Manufacturing Practices for Pharmaceuticals (e-resource): A Plan for Total Quality Control. Sidney Willig and James Stoker
	Biotechnology Operations: Principles and Practices, by John M. Centanni, Michael J. Roy; CRC press
	GMP Manual; Publisher Maas & Peither America, Inc. GMP Publishing.

On-line resources to be used if available as reference material

On-line Resources

.....





(Master of Science) (Biochemistry)
(M.Sc.) (Biochemistry) Semester (III)

Course Code	PS03EBIC52	Title of the Course	Plant Biochemistry
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	Students should be able to understand: <ol style="list-style-type: none">1. physiology and biochemistry of plants.2. regulation of growth of the plants3. plant defence against the pathogens and herbivores.
--------------------	--

Course Content		
Unit	Description	Weightage* (%)
1.	Introduction - The aim and scope of Plant Biochemistry Structure and biochemical aspects of specialized plant cell organelles – cell plate, primary and secondary cell walls, plasmodesmata, importance of vacuoles, characteristics of meristematic cells. Water relations of plants – role of water, absorption, adsorption, conduction and transpiration, guttation, water balance and stress. Mineral metabolism – role of different minerals absorption and translocation of inorganic and organic substances.	25
2.	Photosynthesis - Light and pigments; Light dependent reactions of Photosynthesis; Carbon metabolism – The Photosynthetic Carbon Reduction (PCR) cycle; Activation and regulation of the PCR cycle, The C4 syndrome, Crustacean Acid Metabolism (CAM), Regulation of C4 photosynthesis and CAM; Translocation and distribution of photo assimilates, Photorespiration, Factors affecting the rate of photosynthesis. Respiration - Organization of mitochondrial electron transport system in plants, cyanide resistant pathway and alternative oxidase, its role in regulation of mitochondrial electron transport. Transport of metabolites across mitochondrial Membrane. Regulation of	25





	pentose phosphate pathway and its significance. Gluconeogenesis. Anaerobic respiration.	
3.	Plant Hormones - Growth regulating substances and their mode of action. Role of auxins, gibberelic acid, abscisic acid, cytokinins and brassinosteroids in the regulatory cell extension, germination, growth and development. Signal transduction and gene expression. Application of growth regulators in plant tissue culture	25
4.	Secondary metabolism - Special features, formation and functions of phenolic acids, tannins, lignins, flavonoid pigments, surface waxes, cutin and suberin – the plant protective waxes, terpenes. Signaling molecules in defense system in plants (ethylene, Jasmonic acid and Salicylic acid), Pathogenesis Related (PR) Proteins. Nitrogen assimilation and Biological nitrogen fixation.	25

Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.
-------------------------------	---

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to





1.	Students will have clear understanding of water relations and mineral nutrition of plants.
2.	Students will have clear understanding of photosynthesis and carbon metabolism of plants.
3.	The role growth regulators in plant growth and their application in plant tissue culture will be clearly understood
4.	Plant defence and the role secondary metabolism will be made clear

Suggested References:

Sr. No.	References
1.	Taiz, L., & Zeiger, E. (1991). Plant physiology. Redwood City, Calif: Benjamin/Cummings Pub. Co. Chicago (Author-Date, 15th ed.).
2.	W. G. Hopkins, Introduction to Plant Physiology . 2nd edn, John Wiley & Sons Ltd, ISBN 0 -471- 19281- 3.
3.	Hans- Walter Heldt Birgit Piechulla; Plant Biochemistry - 5th Edition - ISBN: 9780128186312

On-line resources to be used if available as reference material

On-line Resources

Related review articles and research papers





Master of Science in Biochemistry
M.Sc. Biochemistry Semester III

Course Code	PS03EBIC53	Title of the Course	Bioinformatics
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	<ol style="list-style-type: none">1. To get knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics2. To explore existing software effectively to extract information from large databases and to use this information in computer modelling3. To get problem-solving skills, including the ability to develop new algorithms and analysis methods.4. To train student for understanding of the intersection of life and information sciences, the core of shared concepts, language and skills the ability to speak the language of structure-function relationships, information theory, gene expression, and database queries.
--------------------	--

Course Content		
Unit	Description	Weightage* (%)
1.	<p>❖ Introduction to Bioinformatics:</p> <ul style="list-style-type: none">▪ Introduction and Bioinformatics Resources:▪ Knowledge of various databases and bioinformatics tools available at these resources, the major content of the databases, Literature databases:▪ Describe about various approaches in genome sequencing and NGS▪ Overview of Sequence trace files (or chromatograms) raw data output from sequencer machines, Assembling and storing of the sequencer data files.▪ Nucleic acid sequence databases: GenBank, EMBL, DDBJ▪ Protein sequence databases: SWISS-PROT, TrEMBL, PIR, PDB, SCOP, CATH▪ Genome Databases at NCBI, EBI, TIGR, SANGER▪ Other Databases of Patterns/Motifs/System Biology (Gene and protein network database and resources) <p>❖ Sequence analysis:</p> <ul style="list-style-type: none">▪ Various file formats for bio-molecular sequences: GENBANK, FASTA, GCG, MSF, NBRF-PIR etc.▪ Basic concepts of sequence similarity, identity and homology, Definitions of homologues, orthologues, paralogues, xenologues.▪ Scoring matrices: basic concept of a scoring matrix, PAM and BLOSUM series.	25%





	<ul style="list-style-type: none">▪ Database Searches: what are sequence-based database searches, BLAST and FASTA algorithms, various versions of basic BLAST and FASTA.▪ Pairwise and Multiple sequence alignments: basic concepts of sequence alignment, Needleman & Wuncsh, Smith & Waterman algorithms for pairwise alignments, Progressive and hierarchical algorithms for MSA.▪ Use of pairwise alignments and Multiple sequence alignment for analysis of Nucleic acid and protein sequences and interpretation of results.	
2.	<ul style="list-style-type: none">❖ Gene prediction:<ul style="list-style-type: none">▪ Gene structure in Prokaryotes and Eukaryotes, Gene prediction methods: Neural Networks, Pattern Discrimination methods, Signal sites Predictions, Evaluation of Gene Prediction methods.❖ Computational RNA Structure analysis:<ul style="list-style-type: none">▪ Secondary and tertiary structure of RNA. Various algorithms of RNA folding and their analysis. Energy minimization in RNA folding. RNA sequence alignment based on secondary structure and its applications in functional genomics and phylogeny.❖ Transcriptomics:<ul style="list-style-type: none">▪ Complete transcript cataloguing and gene discovery sequencing▪ Microarray based technologies and computation based technologies	25%
3.	<ul style="list-style-type: none">❖ Genomics:<ul style="list-style-type: none">▪ Concepts and tools for genomics and comparative Genomics▪ Ancient conserved regions▪ Horizontal gene transfer▪ Functional classification of genes▪ Gene order (synteny) is conserved on chromosomes of related organisms.▪ Prediction of gene function based on a composite analysis.▪ Functional genomics.▪ Putting together all of the information into a genome database.❖ Phylogenetic analysis:<ul style="list-style-type: none">▪ Definition and description of phylogenetic trees and various types of trees, Molecular basis of evolution, Method of construction of Phylogenetic trees: Distance based method (UPGMA, NJ), Character Based Method (Maximum Parsimony and Maximum Likelihood method).	25%
4.	<ul style="list-style-type: none">❖ Proteomics and Protein Computational Biology:<ul style="list-style-type: none">▪ Tools for proteomics: Acquisition of protein structure	25%





	<p>information, databases and applications.</p> <ul style="list-style-type: none"> ▪ Structural classification of proteins, Protein structure analysis structure alignment and comparison, ▪ Secondary structure and evaluation: algorithms of Chou Fasman, GOR methods. ▪ Tertiary Structure: Basic principles and protocols, Methods to study 3D structure; Prediction of specialized structures. Protein folding, Protein modelling, Method of protein structure evaluation; Active site prediction. ▪ Protein-protein and protein-ligand interaction/Docking; Drug Designing, QSAR studies. <p>❖ Protein structure comparison and classification:</p> <ul style="list-style-type: none"> ▪ Classes, Folds, Motif, Domain; ▪ Purpose of structure comparison ▪ Algorithms such as FSSP, VAST and DALI. ▪ Principles of protein folding and methods to study protein folding. 	
--	--	--

Teaching-Learning Methodology	Online / Offline / Presentation / Videos	
--------------------------------------	--	--

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	To get introduced to the basic concepts of Bioinformatics and its significance in Biological data analysis.
2.	To get introduced to the basics and advance of sequence alignment and analysis.
3.	To get overview about biological macromolecular structures and structure prediction methods.
4.	To understand the structural organisation, structural properties and various techniques employed in the structure determination of Biological macromolecules – DNA &





	Protein.
5.	To get exposed to computational methods, tools and algorithms employed for Biological Data Interpretation.
6.	To have hands on training on various computational tools and techniques employed in Biological sequence analysis.
7.	To get exposed to various tools and methodologies used in multiple sequence alignment, phylogenetic analysis and genetic diversity analysis observed in biological sequences.
8.	To impart knowledge on chemical databases, various advanced techniques and tools like docking, QSAR studies etc employed in computational drug discovery.
9.	To get knowledge about various approaches in genome sequencing and NGS.

Suggested References:

Sr. No.	References
1.	Bioinformatics: A Beginners Guide, Clavarie and Notredame
2.	Bioinformatics: David Mount
3.	Bioinformatics: Rastogi
4.	Introduction to Bioinformatics: Arthur M. Lesk
5.	Bioinformatics: Principles and applications, Ghosh and Mallick
6.	Bioinformatics: Genes, Proteins and Computer, C A Orengo
7.	Protein Structure Prediction: Methods and Protocols, Webster, David (Southern Cross Molecular Ltd., Bath, UK)

On-line resources to be used if available as reference material

On-line Resources

Nucleotide Sequence Databases (the principal ones)

- [NCBI](#) - National Center for Biotechnology Information
- [EBI](#) - European Bioinformatics Institute
- [DDBJ](#) - DNA Data Bank of Japan





Protein Sequence Databases

- [SWISS-PROT & TrEMBL](#) - Protein sequence database and computer annotated supplement
- [UniProt](#) - UniProt (Universal Protein Resource) is the world's most comprehensive catalog of information on proteins. It is a central repository of protein sequence and function created by joining the information contained in Swiss-Prot, TrEMBL, and PIR.
- [PIR](#) - Protein Information Resource
- [MIPS](#) - Munich Information centre for Protein Sequences
- [HUPO](#) - HUman Proteome Organization

Database Searching by Sequence Similarity

- [BLAST @ NCBI](#)
- [PSI-BLAST @ NCBI](#)
- [FASTA @ EBI](#)
- [BLAT](#) Jim Kent's Blat is just superb in terms of speed and the integrated view you get for viewing the results

Sequence Alignment

- [USC Sequence Alignment Server](#) - align 2 sequences with all possible varieties of dynamic programming
- [T-COFFEE](#) - multiple sequence alignment
- [ClustalW @ EBI](#) - multiple sequence alignment
- [MSA 2.1](#) - optimal multiple sequence alignment using the Carrillo-Lipman method
- [BOXSHADE](#) - pretty printing and shading of multiple alignments
- [Splign](#) - Splign is a utility for computing cDNA-to-Genomic, or spliced sequence alignments. At the heart of the program is a global alignment algorithm that specifically accounts for introns and splice signals.
- [Spidey](#) - an mRNA-to-genomic alignment program

Protein Domains: Databases and Search Tools

- [InterPro](#) - integration of Pfam, PRINTS, PROSITE, SWISS-PROT + TrEMBL
- [PROSITE](#) - database of protein families and domains
- [Pfam](#) - alignments and hidden Markov models covering many common protein domains
- [SMART](#) - analysis of domains in proteins
- [ProDom](#) - protein domain database
- [PRINTS Database](#) - groups of conserved motifs used to characterise protein families
- [Blocks](#) - multiply aligned ungapped segments corresponding to the most highly conserved regions of proteins

Protein 3D Structure

- [PDB](#) - protein 3D structure database
- [RasMol / Protein Explorer](#) - molecule 3D structure viewers
- [SCOP](#) - Structural Classification Of Proteins
- [UCL BSM CATH classification](#)
- [The DALI Domain Database](#)
- [FSSP](#) - fold classification based on structure-structure alignment of proteins
- [SWISS-MODEL](#) - homology modeling server
- [Structure Prediction Meta-server](#)





- [K2](#) - protein structure alignment
- [DALI](#) - 3D structure alignment server
- [DSSP](#) - defines secondary structure and solvent exposure from 3D coordinates
- [HSSP Database](#) - Homology-derived Secondary Structure of Proteins
- [PredictProtein & PHD](#) - predict secondary structure, solvent accessibility, transmembrane helices, and other stuff
- [Jpred2](#) - protein secondary structure prediction
- [PSIpred \(& MEMSAT & GenTHREADER\)](#) - protein secondary structure prediction (& transmembrane helix prediction & tertiary structure prediction by threading)

Phylogeny & Taxonomy

- [The Tree of Life](#)
- [Species 2000](#) - index of the world's known species
- [TreeBASE](#) - a database of phylogenetic knowledge
- [PHYLIP](#) - package of programs for inferring phylogenies
- [TreeView](#) - user friendly tree displaying for Macs & Windows

Gene Prediction

- [Genscan](#) - eukaryotes
- [GeneMark](#)
- [Genie](#) - eukaryotes
- [GLIMMER](#) - prokaryotes
- [tRNAscan - SE 1.1](#) - search for tRNA genes in genomic sequence
- [GFF \(General Feature Format\) Specification](#) - a standard format for genomic sequence annotation

Metabolic, Gene Regulatory & Signal Transduction Network Databases

- [KEGG](#) - Kyoto Encyclopedia of Genes and Genomes
- [BioCarta](#)
- [DAVID](#) - Database for Annotation, Visualization and Integrated Discovery - A useful server to for annotating microarray and other genetic data.
- [stke](#) - Signal Transduction Knowledge Environment
- [BIND](#) - Biomolecular Interaction Network Database
- [EcoCyc](#)
- [WIT](#)
- [PathGuide](#) A very useful collection of resources dealing primarily with pathways
- [SPAD](#) - Signaling Pathway Database
- [CSNDB](#) - Cell Signalling Networks Database
- [PathDB](#)
- [Transpath](#)
- [DIP](#) - Database of Interacting Proteins
- [PFBP](#) - Protein Function and Biochemical Networks





PROGRAMME STRUCTURE
M.Sc. Biochemistry Semester: IV

Programme Outcome (PO) - For M.Sc. Biochemistry Programme	<ol style="list-style-type: none">1. Biochemistry masters students will be able to comprehend fundamental Biochemistry principles underlying normal physiology and pathogenesis.2. They will develop proficiency in Biochemistry Laboratory experiments as well as theory.3. They will be able to translate their knowledge with a skilful job at various industries and research labs.4. The students will become employable in the fields of Quality Assurance, Production, Research and Teaching in Biopharmaceuticals, Nutraceuticals, Dairy, Agriculture, Environment, Clinical, Biotechnology and Life sciences.
Programme Specific Outcome (PSO) - For MSc Biochemistry Semester - IV	<ol style="list-style-type: none">1. The students will learn principles of important instruments useful in Biochemistry experiments.2. The Biochemistry students will further develop their proficiency in Biochemistry Laboratory experiments as well as theory.3. They will be able to design and carry out standard Biochemistry experiments on their own.
To Pass	<ol style="list-style-type: none">(1) At least 40% marks in each paper at the University Examination and 40% aggregate marks in Internal and External Assessment.(2) At least 33% Marks in each paper in Internal Assessment.





SARDAR PATEL UNIVERSITY
Vallabh Vidyanagar, Gujarat
 (Reaccredited with 'A' Grade by NAAC (CGPA 3.25))
 Syllabus with effect from the Academic Year 2022-2023

Course Type	Course Code	Name Of Course	Theory/ Practical	Credit	Exam Duration in hrs	Component of Marks		
						Internal	External	Total
						Total	Total	Total
Core Course	PS04CBIC51	Animal Biotechnology	T	4	3	30	70	100
	PS04CBIC52	Nutritional and Clinical Biochemistry	T	4	3	30	70	100
	PS04CBIC53	Practical	P	4	4	30	70	100
	PS04CBIC54	Viva-Voce	=	1	1	=	50	50
Elective Course (Any Two)	PS04EBIC51	IPR and Biosafety	T	4	3	30	70	100
	PS04EBIC52	Research Ethics and Scientific Writing	T	4	3	30	70	100
	PS04EBIC53	Practical	P	4	4	30	70	100
	PS04EBIC54	Biomaterials and Tissue Engineering	T	4	3	30	70	100
	PS04EBIC55	Biodiversity and Conservation	T	4	3	30	70	100
	PS04EBIC56	Downstream Processing	T	4	3	30	70	100
	PS04EBIC57	Systems Biology	T	4	3	30	70	100
	PS04EBIC58	Plant Biotechnology	T	4	3	30	70	100
		OR						
Core Course	PS04CBIC51	Animal Biotechnology	T	4	3	30	70	100
	PS04CBIC52	Nutritional and Clinical Biochemistry	T	4	3	30	70	100
	PS04CBIC53	Practical	P	4	6	30	70	100
	PS04CBIC54	Viva-Voce	=	1	1	=	50	50
Elective Course	PS04EBIC59	Dissertation	=	12	=	=	300	300





(Master of Science) (Biochemistry)
(M.Sc.) (Biochemistry) Semester (IV)

Course Code	PS04CBIC51	Title of the Course	Animal Biotechnology
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	Students should be able to : (1) Maintain subculture and cell lines (2) Understand the pharmaceutical importance and toxicological aspects of cell culture
--------------------	--

Course Content		
Unit	Description	Weightage* (%)
1.	Introduction to animal tissue culture (Background, Advantages and limitations of tissue culture, major differences between in vivo and in vitro, types of tissue culture) Biology of cultured cells (Brief description on cell adhesion, cell proliferation, energy metabolism and origin of cultured cells) General out-line of cell types (epithelial tissue, connective tissue, muscular tissue and nervous tissue) Stem cells, germ cells and amniocytes (Culture of embryonic stem cells, culture of amniocytes, applications of stem cells) Aseptic Techniques (Objectives of aseptic techniques, elements of aseptic environment, sterile handling) Sterilization (Different types- dry heat (hot air oven, wet heat (autoclaving), various chemical agents used in sterilization, irradiation techniques (UV and Gamma Ray) Culture of specialized cells (liver, epidermal, astrocytes, testis and ovary)	25
2.	Defined media and supplements (Physicochemical properties, balanced salt solutions, serum, selection of medium and serum) Serum- Free Media (Disadvantages of serum, advantages of Serum-free media, Preparation of serum free media, Animal protein free media) Primary culture (Initiation of primary cell culture, isolation of tissue, types of primary culture, mechanical and enzymatic disaggregation) Sub culture and cell lines (Subculture and propagation, routine maintenance, subculture of monolayer and suspension cultures) Monitoring for contamination- Visible microbial contamination, mycoplasma, Viral contamination, Eradication of contamination	25
3.	Cell cloning and selection (Feeder layer, suspension cloning, separation of clones)	25





	<p>Cell separation (Centrifugation, Antibody based techniques, FACS) Cell differentiation (Stem cell plasticity, markers of differentiation, induction of differentiation, differentiation and malignancy) Transformation and Immortalization (Immortalization with viral genes, Immortalization of human fibroblasts, telomerase induced immortalization, Aberrant growth control, tumorigenicity) Characterization (Need for characterization, characterization based on cell morphology, DNA and RNA content, enzyme activity and antigenic markers)</p>	
4.	<p>Animal reproductive biotechnology: artificial insemination, super ovulation, embryo recovery and in vitro fertilization, ISCI, ZIFT, GIFT, 3 D culture and Idmoc, culture and cryopreservation of embryos, applications of transgenic animal biotechnology; animal cloning- basic concept, cloning for conservation of endangered species. Vaccinology: conventional methods of animal vaccine production, recombinant approaches to vaccine production, modern vaccines.</p>	25

Teaching-Learning Methodology	<p>Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.</p>
-------------------------------	--

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Student should be able to maintain and work in animal cell culture as well as vaccine production lab





Suggested References:

Sr. No.	References
1.	Freshney, R. I. (2015). Culture of Animal cells: a manual of basic technique and specialized applications (6 th Edn). John Wiley & Sons, Chicago.
2.	Masters, J. R. (2000). Animal Cell Culture: a practical approach (3 rd Edn). Oxford University Press, UK.
3.	Davis, J. M. (Ed.) (2000). Animal Cell Culture: essential methods. John Wiley and Sons, UK.
4.	Gilbert, S. F. (2020). Developmental biology. (12 th Edn.) Sunderland, Mass: Sinauer Associates.

On-line resources to be used if available as reference material

On-line Resources

Related review articles and research papers





Master of Science
M. Sc Biochemistry Semester IV

Course Code	PSO4EBIC58	Title of the Course	PLANT BIOTECHNOLOGY
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	<ol style="list-style-type: none">1.To make the students understand the concepts of modern techniques in plant propagation2.To facilitate the students with knowledge on recent developments in crop improvement3. To address the pros and cons of GM crops.4. To facilitate technical and theoretical know how for the application of molecular tools in crop improvement and crop production.
--------------------	--

Course Content		
Unit	Description	Weightage* (%)
1.	Cell & tissue culture in plants; in-vitro morphogenesis, organogenesis and embryogenesis; Artificial Seeds, Micro propagation (Clonal propagation); Haploidy; anther and ovule cultures, Embryo cultures; Protoplast isolation, culture and protoplast fusion and somatic hybridization, Cybrids, Somaclonal Variation;; Virus elimination, pathogen indexing; Cryopreservation	25%
2.	Production of secondary metabolites; Sources of plant secondary metabolites;criteria for cell selection, factors affecting the culture of cells; different bioreactorsand their use in secondary metabolite production; biochemical pathways for theproduction of different secondary metabolites; and biotransformation.	25%
3.	Methods for genetic transformation and transgenic plants production through <i>Agrobacterim tumefaciens</i> and <i>A. rhizogenes</i> ; Gene transfer methods in plants; PEG mediated, particle bombardment, Molecular markers and their importance in plant breeding, Marker Assisted Selection (MAS).	25%
4.	Commercially grown Transgenic plants: BT crops, Golden rice, transgenic crops for herbicide tolerance, disease and abiotic stress resistance. Indian laws and regularions for the release and cultivation of transgenic plants. Biotechnology and intellectual property rights (IPR); Plant geneticresources GATT & TRIPS; Patent for higher plant genes and DNA sequence	25%

Teaching-Learning	Topics will be taught and discussed in interactive sessions using
-------------------	---





Methodology	conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.
-------------	---

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the significance of plant biotechnology for improving crop productivity
2.	They can apply this knowledge to establish clonal propagation methods for important as well as endangered plants
3.	Students will also understand the pros and cons of transgenic plants as well as intellectual property management and handling of GMOs.
...	

Suggested References:	
Sr. No.	References
1.	Plant Biotechnology: The genetic manipulation of plants – Adrial Slater, Nigel W. Scott and Mark R. Fowler
2.	An Introduction to Plant Biotechnology: H.S. Chawla
...	





On-line resources to be used if available as reference material

On-line Resources





Master of Science (Zoology)
M.Sc. Zoology Semester III

Course Code	PS04CZOO52	Title of the Course	Molecular and Applied Endocrinology
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	<ol style="list-style-type: none">1. To explain characteristics of different endocrine glands and their secretions2. To examine the structural and functional relationships amongst hypothalamus, pituitary and other glands3. To study the chemical classes of hormones and mechanism of hormone action4. To correlate the normal vs pathophysiological conditions of endocrine organs and glands5. To review the bioanalytical techniques for hormone estimation
--------------------	--

Course Content		
Unit	Description	Weightage* (%)
1.	Introduction: A brief history of discovery of hormones. An overview of vertebrate endocrine system. Structural features and hormones of endocrine glands- hypothalamus, pituitary, pineal, thyroid, parathyroids, GI tract, pancreatic islets, adrenals and gonads. Endocrine methodologies: Ablation and replacement, bioassays, immunoassays, Immunocytochemistry, autoradiography, electrophysiological and pharmacological methods, hormone-receptor interactions, cloning techniques.	25
2.	General classes of hormones: Peptide, Thyroid, Steroid, Neurotransmitters, Neuropeptides, Chalcones, Peptide-growth stimulating factors, Eicosanoids and pheromones Hormones and endocrine glands: Synthesis and control of synthesis, Storage, Metabolism and functions. Endocrinology of pregnancy, Parturition and Lactation.	25
3.	Mechanisms of hormone action: Receptors and types- Membrane receptors, Nuclear receptors; Receptor regulation and signal transduction, Second messengers, Permissive actions of hormones and termination of hormone action.	25
4.	Pathophysiology of hypothalamic, pituitary, pineal, thyroid, parathyroid, GI tract, pancreatic islets, adrenal and gonadal hormones. Imaging and nuclear medicine in endocrine disease and hormone-replacement therapies.	25





Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.
-------------------------------	---

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Awareness about the structure and function of endocrine glands and organs
2.	Learn about Hypothalamo-pituitary axis and interactions with other endocrine secretions
3.	Examine the hypo- and hyper- levels of hormones leading to endocrine pathologies
4.	Understand electrophysiological and endocrine methodologies

Suggested References:	
Sr. No.	References
1.	Bolander, F., F., (1989). Molecular Endocrinology. 3 rd Edn. Academic Press, Elsevier, United States
2.	Lodish, H., Berk, A., Kaiser, C., Kreiger, M., Scott, M., Bretscher, A., et al., (2008). Molecular Cell Biology. 6 th Edn. WH Freeman and Company, New York
3.	Norris, D. O., Carr, J., A., (2013). Vertebrate Endocrinology. 5 th Edn. Academic Press, New York
4.	Tortora, G. J., & Grabowski, S. R. (2017). Principles of Anatomy and Physiology (15 th Edn). HarperCollins College, New York.





5.	Brook, C., G., D., Marshall, N. J., (2001). Essential Endocrinology. 4 th Edn. Wiley-Blackwell Publishing, United States
----	---

On-line resources to be used if available as reference material
On-line Resources
Relevant review articles/research papers/handouts of latest development in the subject





(Master of Science) (Biochemistry)
(M.Sc.) (Biochemistry) Semester (IV)

Course Code	PS04CBIC52	Title of the Course	Nutritional and Clinical Biochemistry
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	Students should be able to : (1) relate nutrition to the metabolism (2) Understand pathological conditions of Diabetes, obesity and protein Calorie malnutrition
--------------------	--

Course Content		
Unit	Description	Weightage* (%)
1.	Basic concept- composition of human body: Energy content of food. Measurements of energy expenditure. Energy requirements of man, woman and factor affecting energy requirements, Basal metabolic rate, factors affecting BMR. Carbohydrates- Dietary requirements and sources of available and unavailable carbohydrates and action of dietary fibers. Disorders of carbohydrate metabolism: Glycosuria, Diabetes mellitus.	25
2.	Proteins: protein reserves of body. Nitrogen balance studies and factor affecting it. Protein quality and essential amino acids. Cereal proteins requirement at different stages of development Protein energy malnutrition (PME)-Marasmus and Kwashiorkor disease. Starvation –protein metabolism in prolonged fasting, high proteins, low weight reducing diets.	25
3.	Lipids-major classes of dietary lipids. Properties and composition of plasma lipo-proteins. Essential fatty acid and their physiological function. Clinical inter-relationship of lipids, lipoproteins and apolipoproteins. Tests for apolipoproteins, HDL, LDL, cholesterol and Triglyceride disorder. Obesity-factor leading to obesity –environmental and genetic. Role of leptin in regulation of body mass.	25
4.	Electrolytes and water balance	25





	<p>Clinical Nutrition: Role of diet & nutrition in prevention and treatment of diseases. Dental caries, Fluorosis, Renal failure, Hyperlipidemia, Atherosclerosis. Inherited metabolic disorders: Phenylketonuria, Maple syrup disease, Homocystinuria, Galactosemia, Gout, Diabetes Insipidus and Diabetes mellitus.</p> <p>Anti-nutrients-naturally occurring food born toxicants, Protease inhibitors, hepatotoxins, allergens, toxins from mushroom, animal and sea foods.</p>	
--	--	--

Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.
-------------------------------	---

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand, follow and advise nutritional principles for maintenance of health

Suggested References:





Sr. No.	References
1.	M. Swaminathan (2017). Food and Nutrition (2 nd Edn). The Bangalore Printing and Publishing Co. Ltd., Bangalore.
2.	Victor Rodwell, David Bender, et al. (2018). Harper's Illustrated Biochemistry (31 st Edn). McGraw-Hill Education, Ahmedabad.
3.	Tom Brody. (2 nd Ed.) (1998). Nutritional Biochemistry. Academic Press, United States.
4.	Nelson David L. and Cox Michael M. (2017). Lehninger Principles of Biochemistry (7 th Edn). W.H.Freeman & Co Ltd, Macmillan Publishers, United States.

On-line resources to be used if available as reference material
On-line Resources
Related review articles and research papers





Course Code	PS04CBIC53	Title of the Course	LAB-I
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	<ol style="list-style-type: none">1. To learn lab lay out for animal cell culture laboratory.2. To learn maintain sterile conditions and culture cell lines.3. To learn to estimate various biochemical parameters in clinical specimens.4. To learn to carry out nutritional analysis of biological samples.
--------------------	--

PS04CBIC54 (Lab 1)

1. Lab instruments (CO₂ incubator, biosafety, inverted microscope)
2. Viable count (trypan blue)
3. MTT assay
4. Primary and secondary culture of animal cells
5. Citric acid estimation
6. Vitamin C estimation
7. Glucose tolerance test
8. Estimation of total protein, carbohydrate and lipids from plant seeds and calculation of calorific value
9. Measurement of Basal Metabolic index
10. Electrophoresis of serum proteins

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to





1.	Culture and maintain cell lines.
1.	Do cell viability studies.
2	Carry out nutritional analysis of fruits and other plant products.
3.	Work in a Clinical Biochemistry laboratory.

References:

1	Thimmaiah S. K. (2012). Standad Methods of Biochemical Analysis. Kalyani Publishes, New Delhi, India.
---	---





Master of Science in Biochemistry
M.Sc. Biochemistry Semester IV

Course Code	PS04EBIC51	Title of the Course	IPR and Biosafety
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	<ol style="list-style-type: none">1. To introduce basic concepts of ethics and safety that are essential for different disciplines of science and procedures involved and protection of intellectual property and related rights.2. To understand balanced integration of scientific and social knowledge in sustainable development.
--------------------	--

Course Content		
Unit	Description	Weightage* (%)
1.	<p>Biotechnology and society: Biotechnology and social responsibility, public acceptance issues in biotechnology, issues of access, ownership, monopoly, traditional knowledge, biodiversity, benefit sharing, environmental sustainability, public vs private funding.</p> <p>Bioethics: Social and ethical issues in biotechnology. Principles of bioethics. Ethical conflicts in biotechnology- interference with nature, unequal distribution of risk and benefits of biotechnology, bioethics vs business ethics. Introduction and need of bioethics, its relation with other branches, types of risk associated with genetically modified microorganisms, Ethical Issues involving GMOs; ethics related to human cloning, human genome project, prenatal diagnosis, agriculture and animal rights, data privacy of citizens health; ethical issues in India and abroad through case studies; Socio-economic impact of biotechnology.</p>	25%
2.	<p>Bio- safety: Definition of bio-safety; History, evolution and concept of biosafety; need and application of biosafety in laboratories and industries; biosafety guidelines and regulations, international and national norms of biosafety; Implementation of biosafety guidelines; Classification and Description of Biosafety levels; Design of clean rooms and biosafety cabinets; Risk assessment and containment levels; biohazard, bio-medical and hazardous wastes, handling and disposal; transportation of biological materials; bio-terrorism; biosafety protocol (Cartagena biosafety protocol) regulations to protect nature, growers and consumers interest and nation interest; Good laboratory practice (GLP) and Good manufacturing practice (GMP), Use of GMO's and their release, GM products, issues in use of GMO's, risk for animal/human/agriculture and environment owing to GMOs., Biotechnology and bio-safety concerns at the level of individuals,</p>	25%





	institutions, society, region, country and world. Bio safety regulation: handling of recombinant DNA products and process in industry and in institutions.	
3.	<p>IPR I: The Concept/History of Intellectual Property; Intellectual Property System in India; Kinds of Intellectual Property Rights; Advantages and Disadvantages of IPR. International Instruments concerning Intellectual Property Rights: the Berne Convention, Universal Copyright Convention, The Paris Convention, Patent Co-operation Treaty, Trade Related Intellectual Property Rights (TRIPS), The World Intellectual Property Organization (WIPO) and the United Nations Educational, Scientific and Cultural Organization (UNESCO) World Intellectual Property Organisation (WIPO); World Trade Organization (WTO) European Patent Office (EPO). Patents Act, 1970 ; Trade Mark Act, 1999; The Designs Act, 2000; The Geographical Indications of Goods (Registration and Protection) Act, 1999; Copyright Act, 1957 ; The Protection of Plant Varieties and Farmers' Rights Act, 2001; The Semi Conductor Integrated Circuits Layout Design Act, 2000; Trade Secrets; Utility Models; IPR & Biodiversity; The Convention on Biological Diversity (CBD) 1992;</p> <p>Application forms of IPR and Intellectual property protection. Concept of property with respect to intellectual creativity, Tangible and Intangible property.</p>	25%
4.	<p>IPR II: Classification of patents in India, Classification of patents by WIPO, Categories of Patent, Special Patents, Patenting Biological products, Patent document, Granting of patent, Rights of a patent, Patent Searching, Patent Drafting, filing of a patent, different layers of the International patent system, Utility models, Concept related to patents novelty, non-obviousness, utility, anticipation, prior art etc. Type of patents. Indian patent act and foreign patents. Patentability, Patent application, Revocation of patent, Infringement and Litigation with case studies on patent, Commercialization and Licensing. Patent Cooperation Treaty (PCT);</p> <p>Copyright Overview of Copyright, Importance of Copyrights, Process for copyright, case studies.</p> <p>Overview of Trademarks & Trade Secret, Importance of Trademarks & Trade secret, Rights of Trademark & Trade Secret, Types of Trademarks, Registration process for Trademark & Trade Secret, Duration of Trademark and trade secret, Case Studies</p> <p>Geographical Indications Overview of Geographical Indications, Importance of Geographical Indication Protection, Case studies</p>	25%





	Infringement: Direct, Contributory, and Induced Infringement; How Infringement is Determined; Who Is an Infringer; Official Machinery, Controller, Powers and Functions Defences to Infringement; Case studies	
--	--	--

Teaching-Learning Methodology	Online / Offline / Presentation / Videos
-------------------------------	--

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Interpret basics of biosafety and bioethics and its impact on all the biological sciences and the quality of human life.
2.	Recognize importance of biosafety practices and guidelines in research.
3.	Comprehend benefits of GM technology and related issues.
4.	Recognize importance of protection of new knowledge and innovations and its role in business.

Suggested References:	
Sr. No.	References
1.	Fleming, D.A., Hunt, D.L., (2000). Biotechnology and Safety Assessment (3rd Ed) Academic press. ISBN-1555811804, 9781555811808.
2.	Thomas, J.A., Fuch, R.L. (1999). Biotechnology and safety assessment (3rd Ed). CRC press, Washington. ISBN: 1560327219, 9781560327219





3.	Law and Strategy of biotechnological patents by Sibley. Butterworth publication.(2007) ISBN: 075069440, 9780750694445.
4.	Intellectual property rights- Ganguli-Tat McGrawhill. (2001) ISBN-10: 0074638602,
5.	Intellectual Property Right- Wattal- Oxford Publicatiopn House.(1997) ISBN:0195905024.
6.	Biotechnology - A comprehensive treatise (Vol. 12). Legal economic and ethical dimensions VCH. (2 nd ed) ISBN-10 3527304320.
7.	Encyclopedia of Bioethics 5 vol set, (2003) ISBN-10: 0028657748.
8.	Thomas, J.A., Fuch, R.L. (2002). Biotechnology and safety Assessment (3 rd Ed) Academic press.
9.	B.D. Singh. Biotechnology expanding horizons.
10.	H.K.Das. Text book of biotechnology 3 rd edition.
11.	<i>Sateesh, M.K., Bioethics and Biosafety, IK International Publishers (2008)</i>
12.	<i>Singh I. and Kaur, B., Patent law and Entrepreneurship, Kalyani Publishers (2006).</i>
13.	<i>Srinivasan, K. and Awasthi, H.K., Law of Patents, Jain Book Agency (1997)</i>
14.	Deepa Goel, ShominiParashar, (2013), IPR, Biosafety and Bioethics, Pearson.

On-line resources to be used if available as reference material

On-line Resources





Master of Science
M. Sc Biochemistry Semester IV

Course Code	PSO4EBIC52	Title of the Course	RESEARCH ETHICS AND SCIENTIFIC WRITING
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	<ol style="list-style-type: none">1. To inculcate professional ethics in students of Science, especially in Biology2. To familiarize types of plagiarism and tools for their detection3. To teach various modes of data collection and its processing4. To impart professional, scientific writing skills <p>...</p>
--------------------	---

Course Content		
Unit	Description	Weightage* (%)
1.	Definition and significance of ethics; Professional ethics in Scientific research and development: Common ethical breaches; data fabrication; data falsification. Plagiarism: redundant publication; duplicate publication.	25%
2.	Types of plagiarism; tools and techniques for detection of plagiarism. Conflict of interest; salami slicing and authorship issues. Good Laboratory Practices (GLP): Instrument validation, reagents and materials certification, documentation and its record, Quality assurance and certification of laboratory facilities.	25%
3.	Data collection methods: Primary data and secondary data. Internet, online data collection, journals and books. References: Basic types of referencing; Quoting, paraphrasing and citing. APA, MLA and the Chicago/ Turabian styles of listing references.	25%
4.	Scientific writing: Basic differences between popular and scientific writing; fundamental rules of scientific writing; structure and content of research papers, thesis and dissertations. Do's and don't for scientific writing. Tools and techniques for correction and editing of manuscripts. Selection and publication in journals.	25%

Teaching-Learning	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power
-------------------	---





Methodology	point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.
-------------	---

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the significance of professional ethics in Scientific research
2.	Appreciate the types and pitfalls of plagiarism
3.	Learn how to collect data from primary and secondary sources
4.	Understand the differences between, common, popular and scientific writing and learn the basics of scientific writing

Suggested References:	
Sr. No.	References
1.	Professional ethics and human values: M. Govindarajan, S. Natarajan and V.S. Senthilkumar
2.	The craft of Scientific writing: Michael Alley
3.	Science and Technology ethics: Raymond Spier
4.	Scientific writing and research quality: Prasanna Kumar and Pawan Kumar Bharti





On-line resources to be used if available as reference material

On-line Resources





Master of Science
M. Sc. Biochemistry Semester IV

Course Code	PSO4EBIC54	Title of the Course	BIOMATERIALS AND TISSUE ENGINEERING
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	<ol style="list-style-type: none"> 1. To impart knowledge on the types and properties Biomaterials used in medicine. 2. Understand the composition of implants and their pros and cons. 3. Learn tissue engineering and its applications 4. Gain an understanding of stem cells and their emerging role in treatment of genetic and somatic disorders.
--------------------	--

Course Content		
Unit	Description	Weightage* (%)
1.	Biomaterials: Introduction-definition of biomaterials, applications of biomaterials, classification of biomaterials, Comparison of properties of some common biomaterials. Effects of physiological fluid on the properties of biomaterials. Biological responses (extra and intra-vascular system). Surface properties, physical properties and mechanical properties of materials. Types of implant materials: Metallic, polymeric, ceramic and composite materials.	25%
2.	Properties of commonly used implant materials: Stainless steel and alloy importance of stress- corrosion cracking; role of passive films in tissue adhesion. Polymeric implant materials: general classification; Polyolefins polyamides, acrylic polymers, fluorocarbon polymers, silicon rubbers, acetals. Biodegradable polymers and synthetic polymers and their applications. Ceramic implant materials: Bioceramics; Common types of bioceramics. Bio-reabsorbable and bioactive ceramics Host tissue reactions: importance of interfacial tissue reaction (e.g. ceramic/bone tissue reaction). Composite implant materials: different reinforcement materials, Composite theory of fiber reinforcement.	25%
3.	Tissue engineering: Introduction, stem cells, morphogenesis, generation of tissue in the embryo, Tissue homeostasis, Cellular signaling Extracellular matrix as a biologic scaffold for tissue engineering Scaffold fabrication, bioactive scaffold, Natural polymers in tissue engineering applications, Degradable polymers for tissue engineering.	25%
4.	Basic Biology Of Stem Cells: Stem Cells : Introduction, hematopoietic differentiation pathway; Potency and plasticity of stem cells, source	25%





	embryonic stem cells, hematopoietic and mesenchymal stem cells, Stem Cell markers, FACS analysis and differentiation. Stem cell system Liver, neuronal stem cells, Types and sources of stem cell with characteristics: embryonic, adult, haematopoietic, fetal, cord blood, placenta, bone marrow, primordial germ cells, cancer stem cells induced pluripotent stem cells.	
...		

Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.
-------------------------------	---

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand about various types of biomaterials for a wide range of biomedical applications.
2.	Basic functions and performance of implant materials as well as corrosion and degradation mechanisms of biomaterials.
3.	Choice of biomaterials based on function, biological environments, toxicity, bioadhesion and implant surface interaction with tissues. Scaffolds for tissue-engineering, growth factor, stem cell signaling.
...	





Suggested References:

Sr. No.	References
1.	Tissue Engineering: Bernhard O Palsson, Sangeeta N. Bhatia.
2.	Fundamentals of Tissue Engineering and Regenerative Medicine: Meyer, U,; Meyer, Th.; Handschel, J.; Wiesmann, H.P .
3	Biomaterials: Science and Engineering: J B Park
4	Biomaterials: Sujata V. Bhat

On-line resources to be used if available as reference material

On-line Resources





(Master of Science) (Biochemistry)
(M.Sc.) (Biochemistry) Semester (IV)

Course Code	PS04EBIC55	Title of the Course	Biodiversity and Conservation
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	<ol style="list-style-type: none">1. To impart knowledge of fundamental concepts of biodiversity, the range of its extant and the need for conservation.2. To provide information of the main threats to biological diversity and the ability to evaluate the effects of human influences on biodiversity.3. To demonstrate the differences between the different categories of red listed species.4. To understand different modes of biodiversity conservation, their merits and limitations.5. To integrate the information generated from scientific investigations and use findings to address conservation and biodiversity issues.
--------------------	---

Course Content		
Unit	Description	Weightage* (%)
1.	Biodiversity: Concepts, levels and types, changes in time and space, evolution, species concept; significance of biodiversity for life security. Biogeography. Terrestrial, Marine, Aquatic and Agricultural biodiversity: Changing patterns and practices. Influence of modern lifestyle on biodiversity. Pros and cons of genetically modified species	25
2.	Global conservation measures, institutions and conventions; IUCN concept of threatened and endangered species. The Red Data Books of Indian plants and animals. Causes and consequences of loss of biodiversity. Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES): aims, major ratifications and amendments. Exotic and invasive species: A few case studies of intentional and non-intentional introduction of exotic species and their influence on local biodiversity.	25
3.	Principles and strategies of biological diversity conservation: <i>in-situ</i> conservation and <i>ex-situ</i> conservation. Biosphere reserves, major protected areas (sanctuaries, national parks, biosphere reserves) of India and Gujarat. Wetlands, mangroves and coral reefs for conservation of wild biodiversity. Concept of Sacred groves and their role in biodiversity conservation.	25





	Role of botanical gardens, field gene banks, seed banks, in vitro repositories, cryobanks in conservation of plants and animal sperms. Role of Zoos, breeding centers in conservation of animals.	
4.	<p>Biodiversity hot spots in India and world; Indian Biodiversity Act 2002; Major objectives of biodiversity authority board; Biodiversity and economics with special reference to India; People's Biodiversity register: Objectives, importance and modality of preparation.</p> <p>General account of the activities of Botanical Survey of India (BSI) and Zoological Survey of India (ZSI), National Bureau of Plant Genetic Resources (NBPGR), Indian Council of Agricultural Research (ICAR), Council of Scientific & Industrial Research (CSIR), Department of Biotechnology (DBT) and Department of Environment and Forest, Wild life Protection Society of India, Wildlife Institute of India (WII), Animal Welfare Board of India and Bombay Natural History Society (BNHS) in the context of Indian biodiversity conservation.</p>	25

Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.
-------------------------------	---

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the concept of biodiversity, its role for our survival, different direct and indirect threats on biodiversity.





2.	Appreciate the global and national initiatives and local traditions for biodiversity conservation.
3.	Become familiar with different modes of conservation, institutes involved in biodiversity conservation.
4.	Learn various guidelines and regulations for utilizing the biodiversity judiciously.

Suggested References:

Sr. No.	References
1.	Wilson, E., O., (1988). Biodiversity. The National Academies Press. Harvard. Washington, DC.
2.	Hunter, M., L., Gibbs, J. P., (2007). Fundamentals of Conservation Biology. 3 rd Edn. Blackwell Publishing, Malden.
3.	Myers, N., Mittermeier, R., A., Mittermeier, C. G., Fonseca, G., A., da, Kent, J., (2000). Biodiversity Hotspots for Conservation Priorities. Nature, 403, 853-858.
4.	Rodgers, N. A., Panwar, H. S. Planning a Wildlife Protected Area Network in India. Vol. 1. The Report Wildlife Institute of India, Dehradun.

On-line resources to be used if available as reference material

On-line Resources

Biodiversity: **Author:** John Spicer

Brian W. van Wilgen: Biological Invasions in South Africa

Recent review articles and research papers





(Master of Science) (Biochemistry)
(M.Sc.) (Biochemistry) Semester (IV)

Course Code	PS04CIBT57	Title of the Course	Downstream processing
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	Students should be able to : - Device a strategy and separate bioactive molecules.
--------------------	---

Course Content		
Unit	Description	Weightage* (%)
1.	Introduction to downstream processing principles, characteristics of biomolecules and bioprocesses. Cell disruption for product release – mechanical, enzymatic and chemical methods. Pretreatment and stabilization of bio products.	25
2.	Physical methods of separation: centrifugation and filtration. Adsorption, liquid-liquid extraction, aqueous two-phase extraction, membrane separation – ultrafiltration and reverse osmosis, dialysis, precipitation of proteins by different methods.	25
3.	Purification methods: Chromatography – principles, instruments and practice, adsorption, Reverse phase, ion-exchange, size exclusion, hydrophobic interaction, bio affinity and pseudo affinity chromatographic techniques.	25
4.	Purification strategies: Case studies of animal based products -Tissue Plasminogen Activator, Erythropoietin; plant based products- shikonin and seed proteins; bacterial products- lipases, amylase, subtilisin, ethanol and citric acid.	25

Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.
-------------------------------	---





Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Students should be able to handle down stream processing laboratory.

Suggested References:	
Sr. No.	References
1.	Gary Walsh Proteins: Biochemistry and Biotechnology. 2nd edition, Wiley Blackwell. 2002
2.	J.C. Janson and L. Ryden, (Ed.) – Protein Purification – Principles, High Resolution Methods and Applications, VCH Pub. 1989.
3.	R.K. Scopes – Protein Purification – Principles and Practice, Narosa Pub., 1994.
4.	B. Sivasanker –Bio separations –Principles and Techniques, Prentice –Hall of India, 2005.
5.	Roger G.Harrison, Paul Todd- Bioseparations Science and Engineering, Oxford University Press, 2006.
6.	D. G. Rao, Introduction to Biochemical Engineering, Tata McGraw-Hill Education, 2005.

On-line resources to be used if available as reference material
On-line Resources
Related review articles and research papers





(Master of Science) (Biochemistry)
(M.Sc.) (Biochemistry) Semester (IV)

Course Code	PS04EBIC57	Title of the Course	Systems Biology
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	1. To introduce the concept of systems and synthetic Biology to the students 2. To provide insight into quantitative modelling of biological systems at the molecular and cellular level, as well as how they are used, analysed and developed
--------------------	---

Course Content		
Unit	Description	Weightage* (%)
1.	Concepts and working principles of System Biology - Practical applications of System Biology in Life Sciences - Introduction to System Biology platforms, Proprietary system Biology platform. Microarray data analysis - Microarray analysis platforms - Introduction to Concepts and principles of Microarray technology	25%
2.	Models and Modeling: purpose, adequateness, advantage of computational modeling, basic notion for computational models, model scope, statements, system state, variables parameters constants, behavior, classification, steady states.	25%
3.	Analysis of complex biological systems: Sequencing (DNA & amino acid), Protein structure analysis. Metabolic networks and flux balance analysis: Mathematical modeling of metabolic networks; formulation and optimization of Flux Balance Analysis; computational tools for FBA.	25%
4.	Introduction to synthetic biology. Modeling synthetic Biology; Applications of synthetic Biology. Human and Pathogens--Cancer genomics (Tumor complexity)--Gene regulatory network Codon optimization Algorithmic Drug designs. Current and emerging areas in the field of computational and systems biology.	25%
...		

Teaching-	
-----------	--





Learning Methodology	
----------------------	--

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Model macromolecular complexes on different time and length scales model macromolecular structures with the help of experimental information
2.	Explain cellular processes by describing the interactions between macromolecules in a kinetic network
3.	Appreciate the significance of synthetic Biology and its potential in future
...	

Suggested References:	
Sr. No.	References
1.	System Biology: Computational Systems Biology (Hardcover) by Andres Kriete (Editor), Roland Eils (Editor)
2.	Microarray Data Analysis: Gene Expression Data Analysis. A Beginner's Guide By: Helen Causton (Imperial College), J Quackenbush and Alvis Brazma (The European Bioinformatics Institute)





3	Klipp E (2009) Systems biology: a textbook. Wiley-VCH, 1/e.
---	---

On-line resources to be used if available as reference material
On-line Resources

