MSc Biotechnology Semester I

Course Code	Name of the Course	Credits
	MAJOR:	
VBB500	**1.** Biochemistry	4
VBPR501	**2.** Biochemistry Practical	2
VBMB502	**3.** Molecular Biology	4
VBPR503	**4.** Molecular Biology Practical	2
VBIP504	**5.** Basics in IPR & patents	2
	ELECTIVE:	
VBI505	Immunology	4
VBMD506	Molecular Diagnostics	4
	RM	
VBRM507	Research Methodology.	4
		22

MSc Biotechnology Semester II

Course Code	Name of the Course	Credits
	MAJOR:	
VBBB550	Bioinformatics & Biostatistics	4
VBPR551	Bioinformatics & Biostatistics Practical	2
VBBT552	Bioprocess Technology	4
VBPR553	Bioprocess Technology Practical	2
VBCS554	Clinical Studies	2
	ELECTIVE:	
VBBB555	Biochemical and Biophysical Techniques	4
VBE556	Bio-entrepreneurship	4
	OJT / FP	
VBFP557	On job Training / Field Project.	4
		22

SEMESTER I

M. Sc (Biotechnology)		Semester – I	
Course Name: Biochemistry		**Course Code: VGVPSBMBC101**	
Periods per week (1 Period is 60 minutes)		**4**	
Credits		**4**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2**	**60**
	Internal	**--**	**40**

Course Objective
To enable the learner to:
Understand the DNA topology and structure
Understand the metabolism of various biomolecules
Understand membrane biochemistry
Understand concepts in enzymology

Unit	Details	Lectures
I	**DNA topology** DNA topology: Different forms of DNA – A, B, C, Z andRL form of double helical DNA, triple helix. Nucleic acidbinding proteins – Leucine zipper, zinc finger, OB fold, B- barrel, helix turn-helix, helix -loop -helix. Linking number, supercoiling, Topoisomerases.	15
II	**Metabolism** Lipid metabolism: Phospholipids, Cerebrosides and Gangliosides; Alzheimer's disease; Steroid hormones, lipid storage diseases Biosynthesis of purines and pyrimidines with regulation, disorders of Nucleic acid metabolism. Biosynthesis of essential amino acids. Disorders of amino acid metabolism Glycosaminoglycans- Heparin, Chondroitin sulphate, Hyaluronic acid Glycoproteins & Glycolipids, Acidic sugars – ascorbic, glucuronic acid.	15
III	**Membrane Biochemistry** Membrane Chemistry and transport of solutes across the membrane; States of bilayer lipids, Trans-bilayerMovement of Lipids, Flip-flop diffusion. Measurement oflateral diffusion rates of lipids by fluorescence recovery after photobleaching (FRAP). Hop diffusion of individual lipid molecules; Caveolins and cadherins; Membrane Fusion; Transporter classification system channel (Na+ channel of neurons) and ligand (acetylcholine) mediated transport with examples. ABC transporters and Ionophores.	15

IV	**Enzymology** Enzyme classification, kinetics, stable state kinetics, enzyme inhibitions, Enzyme regulation, Allosteric Enzymes, Isozymes, Catalytic antibodies, Ribozymes. Regulatory enzymes and their mode of action and covalent modification of enzymes. Enzyme immobilization techniques, Enzyme biosensors. Enzyme engineering-Principle, Steps involved, and applications.	15

Course Outcome	
Learner will be able to	
CO1	Corelate the DNA structure and functionality.
CO2	Apply the concept of metabolism of various biomolecules to study human metabolism
CO3	Corelate membrane biology of prokaryotes & eukaryotes.
CO4	Understand enzyme kinetics and different aspects of enzymology.

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1	Principles of Biochemistry	Lehninger	Freeman NY	6th	2012
2	Biochemistry	Voet & Voet	Wiley & Sons	5th	2016
3	Biochemistry	Satyanarayan & Chakrapani	Books & Allied Publication	4th	2017

M. Sc (Biotechnology)		Semester – I	
Course Name: Biochemistry Practical		**Course Code: VGVPSBMBCP101**	
Periods per week (1 Period is 120 minutes)		**2**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Practical Examination**	3	**100**

List of Practical:

1. Isolation of starch from potato and its estimation by Anthrone method.
2. Estimation of Protein by Bradford's method.
3. Purification of protein by ammonium sulfate fractionation, dialyze and separate using PAGE
4. Study of protein complexes using SDS-PAGE and visualization using silver staining.
5. Viscosity studies of Proteins.
6. Determination of Lactate Dehydrogenase (LDH)Activity in Blood Serum.
7. Isolation of cholesterol and lecithin from egg yolks.
8. Study of effect of inhibitors on Enzyme activity
9. Study of Km and Vmax.
10. Titration curve of amino acids

M. Sc (Biotechnology)		Semester – I	
Course Name: Molecular Biology		**Course Code: VGVPSBMMB101**	
Periods per week (1 Period is 60 minutes)		**4**	
Credits		**4**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2**	**60**
	Internal	**--**	**40**

Course Objective
Understand the concept of gene evolution and different aspects of human genome.
Understand the transcription in procaryotes & eukaryotes
Understand the translation in procaryotes & eukaryotes
Understand the use of vectors in cloning

Unit	Details	Lectures
I	**Gene evolution and the human genome** Human mitochondrial genome, content of the human nuclear genome: cis-trans regulatory elements, Introns, pseudogenes, non-coding RNA genes, tandemly repeated DNA, interspersed genome-wide repeats, Mobile genetic elements, Transposable elements in bacteria (Insertion elements, Transposons, Bacteriophage Mu) and eukaryotes (Plant transposable elements, Yeast transposable element, Drosophila transposable elements, Human retrotransposons) Genome evolution - Acquisition of New Genes by gene duplication: causes of gene duplication, whole genome duplication, smaller duplication, rearrangement of existing genes, Acquisition of New Genes from other species. Human genome project	15
II	**Transcription** Transcription in prokaryotes and eukaryotes, Types of RNA polymerases, Transcription in cell organelles,RNA processing in eukaryotes, Synthesis of eukaryotic mRNAs by RNA polymerase II, Intron splicing. Synthesis and processing of Non-coding RNAs: Transcript elongation and termination by RNA polymerases I and III. Degradationof mRNAs. Regulatory RNAs in Prokaryotes: sRNAs, CRISPRs, Regulatory RNAs ineukaryotes: miRNA, siRNA, long non-coding RNAs & their role.	15

III	**Translation** Translation in Prokaryotes and Eukaryotes, Inhibitors of translation, Post translational modification:Protein folding, Processing by proteolytic cleavage, Processing by chemical modification and Inteins splicing. Protein targeting and degradation. Gene silencing, Epigenetic inheritance.	15
IV	**DNA Vectors** pBR322, pUC series vectors, Phagemids, DNA cloning with single-stranded DNA vectors: M13 phages cloning vector, Specialist purpose vectors: M13 based vector for ssDNA. Expression vectors - Vectors for making RNA probes, vectors for maximizing protein synthesis, vectors to facilitate protein purification, vectors to promote protein solubilization, vectors to promote protein export, BACs, Phage P1 derived vectors & PACs.	15

Course Outcome	
Learner will be able to	
CO1	Apply the concept of gene evolution and different aspects of human genome to study genetic diversity
CO2	Understand the concept of transcription in procaryotes & eukaryotes and its role in regulation
CO3	Understand the concept of translation in procaryotes & eukaryotes and its role in the cell.
CO4	Understand the use of vectors in cloning and select the appropriate vector for different cloning experiments.

Books and References:					
Sr. No.	**Title**	**Author/s**	**Publisher**	**Edition**	**Year**
1.	Genomes	T.A. Brown	Bios	8th	2020
2.	iGenetics A Molecular Approach	Peter Russell	Pearson	3rd	2016
3.	Principles of Gene Manipulation	Primrose & Twymann	Blackwell	7th	2006
4.	Biotechnology	S.S. Purohit	Agrobios	4th	2005

M. Sc (Biotechnology)		Semester – I	
Course Name: Molecular Biology Practical		**Course Code: VGVPSBMMBP101**	
Periods per week (1 Period is 120 minutes)		**2**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Practical Examination**	3	**100**

List of Practical:

1. Extraction of genomic DNA from bacteria.
2. Extraction of genomic DNA from blood.
3. Plasmid DNA extraction and detection using agarose gel electrophoresis
4. Perform transformation of bacteria
5. Expression of recombinant protein
6. Restriction digestion
7. Ligation
8. Study of *E.coli* diauxic growth curve- lactose and glucose
9. Induction of β-galactosidase in *E. coli* using blue-white selection.
10. Expression of β-galactosidase and measurement of activity.

M. Sc (Biotechnology)		Semester – I	
Course Name: Basics in IPR & Patents		**Course Code: VGVPSBMIP101**	
Periods per week (1 Period is 60 minutes)		**2**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2**	**60**
	Internal	**--**	**40**

Course Objective
To introduce basic concept of IPR
To familiarize learner with importance of IPR, copyrights, trade marks and statutory provisions.

Unit	Details	Lectures
I	**Introduction to IPR** Introduction to intellectual property; types of IP: patents, trademarks, trade secrets, copyright & related rights, industrial design, geographical indications, Biodiversity importance and legislation, International convention and treaties; plant variety protection and farmers rights act, traditional knowledge.	15
II	**Basics of Patent** Eligibility criteria, concept of novelty, concept of inventive step; Patentable and Non-patentable inventions in India and abroad. Patenting systems. Process of Patenting, Types of patent applications, Patent Search, Rights of the patent holder, Assignment and licensing of patents and patent Infringement, case studies. Patent Agent. Biotechnological Inventions as Patentable Subject Matter, Patentability of Biotechnology Inventions in India, Statutory Provisions Regarding Biotechnological Inventions Under the Current Patent Act 1970 (as Amended 2005).	15

Course Outcome	
Learner will be able to	
CO1	Identify the practice and procedure of patents
CO2	To learn the procedure of obtaining patents, copyrights, trade marks and industrial design.
CO3	To enable the students to keep IP rights alive

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	IPR: unleashing the knowledge economy	P.Ganguli	Tata McGraw Hill		2001
2.	Biotechnology and IPR-Legal and Social implications	Kshitij Kumar Singh	Springer India		2015
3.	IPR in eveloping countriesWTO and d	Shabana Talwar	Serials Publication		2010

M. Sc (Biotechnology)		Semester – I	
Course Name: Immunology		**Course Code: VGVPSBEL101**	
Periods per week (1 Period is 60 minutes)		**2**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2**	**60**
	Internal (Practical)	**--**	**40**

Course Objective

To familiarize students with Immune Effector Mechanisms.
To understand the various immune-techniques used to study immunology.

Unit	Details	Lectures
I	**Understanding the Immune system** Mechanisms of Innate immune system (pattern recognition receptors, complement system, ADCC) and Adaptive immune system (cells involved, Antigen recognition by B cells and T cells, Effector mechanisms) Cytokines: Properties, Classification, Receptors, Signaling. Autoimmunity	15
II	**Humoral & Cell mediated immunity** B cell development: development in Bone marrow, B cell lineages (B1 and B2), Negative regulation of B cells, T dependent and independent responses, Generation of Antibody Diversity: Germ line and Somatic theory, Dreyer and Bennett model. T cell Development: Early thymocyte development, positive and negative selection, Differentiation, maturation, Apoptosis. Transplantation: Basis of Graft rejection, clinical manifestation of graft rejection;immunosuppressive therapy; immune tolerance; clinicaltransplantation. Cancer immunology	15

Course Outcome	
Learner will be able to	
CO1	Understand the role of different types of cells, effector molecules and effector mechanisms in immunology.
CO2	Perform various immune-techniques.

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Immunology	Kuby	Freeman & Co NY	7th	2012
2.	Introduction to Immunology	C.V.Rao	Narosa Publishing House		
3.	Immunology	Roitt	Blackwell	7th	2006

M. Sc (Biotechnology)		Semester – I	
Course Name: Immunology Practical		**Course Code: VGVPSBEL101**	
Periods per week (1 Period is 120 minutes)		**2**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Practical Examination**	**3**	**40**

List of Practicals:

1. DOT-ELISA
2. Quantification of antigen using Single Radial Immuno-Diffusion.
3. Immuno-diffusion and immune-electrophoresis
4. Serum electrophoresis
5. Western Blotting
6. Demonstration of HLA typing.
7. In-vitro demonstration of phagocytosis andcalculating phagocytic index.
8. Latex bead agglutination / precipitation test fordetection of rheumatoid factor (RF)
9. Separation of lymphocytes on Ficoll-Histopaque, viability count.

M. Sc (Biotechnology)		Semester – I	
Course Name: Molecular Diagnostics		**Course Code: VGVPSBEL102**	
Periods per week (1 Period is 60 minutes)		**4**	
Credits		**4**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2**	**60**
	Internal	**--**	**40**

Course Objective

Learning and understanding molecular techniques and applying these techniques in diagnostics.

Unit	Details	Lectures
I	**Introduction to Molecular Diagnostics :** Overview of Molecular Diagnostics; History of Molecular Diagnostics; Molecular Diagnostics in Post Genomic Era; Areas used in Molecular Diagnostics; Future Prospects - Commercialising Molecular Diagnostics, Personalized Medicine, Theranostics. **Characterisation and analysis of Nucleic – Acids and Proteins :** Extraction, Isolation and Detection of DNA, RNA and Proteins; Restriction Endonucleases and Restriction Enzyme Mapping.	15
II	**Hybridisation Techniques :** Southern, Northern, Western and FISH; Markers, Probes and its Clinical Applications. **Target amplification:** PCR, Reverse Transcriptase and Real Time PCR. Probe Amplification, Signal amplification	15
III	**DNA Polymorphism and Identification:** RFLP and Parentage Testing; RFLP and Sickle-Cell anaemia. **Molecular Diagnostics for Infectious Diseases** Molecular Testing for *Neisseria,* Molecular Diagnosis for HIV-1; Clinical utility of molecular diagnostic tests for hepatitis and HIV-1	15
IV	**Genetic Counselling and Molecular Diagnosis** Genetic Testing- Need and Uses; genetic Counselling. Case Studies- Diagnostic Testing for Cystic Fibrosis; Fragile X Diagnostic and Carrier Testing. **Ethical, Social and Legal Issues to Molecular - Genetic Testing**	15

Course Outcome

Gain an understanding of the basic principles used in molecular diagnostics.
Analytical skills to understand new diagnostic methods.
Knowledge useful in developing new diagnostic methods.

Books and References:					
Sr. No.	**Title**	**Author/s**	**Publisher**	**Edition**	**Year**
1.	Molecular Diagnostics	Lela Buckingham	F.A.Davis	2nd	2012
2.	Molecular Diagnostics for the clinical laboratorian	Coleman & Tsongalis	Humana		

M. Sc (Biotechnology)		Semester – I	
Course Name: Research Methodology		**Course Code: VGVPSBRM101**	
Periods per week (1 Period is 60 minutes)		**4**	
Credits		**4**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2**	**60**
	Internal	**--**	**40**

Course Objective

To develop research aptitude, logical thinking and reasoning.
Understand basic principles of research methodology and identify and design a research problem.

Unit	Details	Lectures
I	**Foundations of Research:** Meaning, Objectives,Motivation, Utility. Concept of theory, empiricism,deductive and inductive theory. Characteristics of scientific method – Understanding the language of research – Concept, Construct, Definition, Variable.Research and its types The research process: Problem Identification & Formulation – Research Question – Investigation Question –Measurement Issues – Hypothesis –Qualities of a good Hypothesis –Null Hypothesis &Alternative Hypothesis. Hypothesis Testing – Logic & Importance	15
II	Research Design: Concept and Importance in Research – Features of a good research design, The functions of aresearch design, The theory of causality and the research design, Study designs in quantitative and qualitative research Data Collection: Data and its types, Selecting a methodof data collection Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association.	15

III	The concept of sampling, Sampling terminology, Principles of sampling, Factors affecting the inferences drawn from a sample, Aims in selecting a sample. Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non-Response.Characteristics of a good sample. Probability Sample – Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the sample– Practical considerations in sampling and sample size.	15
IV	Research proposal and its contents, Types of researchpaper, Layout of a Research Paper, Reviewing the literature, Methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office. Journals in Life Science, Impact factor of Journals, When and where to publish? Ethical issues related to publishing, Plagiarism and Self-Plagiarism, Software for detection of Plagiarism.	15

Course Outcome	
Learner will be able to	
CO1	Understand general definition of research design
CO2	Identify the overall process of designing a research study from its inception to its report.

Books and References:					
Sr. No.	**Title**	**Author/s**	**Publisher**	**Edition**	**Year**
1.	Research Methodology	C.R.Kothari			2004
2.	Research Design	John Creswell	Sage	3rd	2017

SEMESTER II

M. Sc (Biotechnology)		Semester – II	
Course Name: Bioinformatics & Biostatistics		**Course Code: VGVPSBMBB201**	
Periods per week (1 Period is 60 minutes)		**4**	
Credits		**4**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2**	**60**
	Internal	**--**	**40**

Course Objective

Understand and interpret data statistically.
Familiarization of statistical software.
Understand biological databases.

Unit	Details	Lectures
I	Bioinformatics basics: Computers in biology and medicine; Introduction to Unix and Linux systems and basic commands; Database concepts; Protein and nucleic acid databases; Structural databases; Biological XML DTD's; pattern matching algorithm basics; databases and search tools: biological background for sequence analysis; Identification of protein sequence from DNA sequence; searching of databases similar sequence; NCBI; publicly available tools; resources at EBI; resources on web; database mining tools. DNA sequence analysis: gene bank sequence database; submitting DNA sequences to databases and database searching; sequence alignment; pairwise alignment techniques; motif discovery and gene prediction; local structural variants of DNA, their relevance in molecular level processes, and their identification; assembly of data from genome sequencing.	15
II	Multiple sequence analysis; multiple sequence alignment; flexible sequence similarity searching with the FASTA3 program package; use of CLUSTALW and CLUSTALX for multiple sequence alignment; submitting DNA protein sequence to databases: where and how to submit, SEQUIN, genome centres; submitting aligned sets of sequences, updating submitted sequences, methods of phylogenetic analysis. Protein modelling: introduction; force field methods; energy, buried and exposed residues; side chains and neighbours; fixed regions; hydrogen bonds; mapping properties onto surfaces; fitting monomers; RMS fit of conformers; assigning secondary structures; sequence alignment- methods, evaluation, scoring; protein completion: backbone construction and side chain addition; small peptide methodology; software accessibility; building peptides; protein displays; substructure manipulations, annealing.	15
III	Introduction and scope of statistics in biological studies and basic concepts. Collection of data, by different sampling methods: Simple random sampling, stratifies random sampling and systemic sampling. Measures of central tendency; Mean, Median and Mode. Measures of Dispersion: Variance/ standard deviation, coefficient of variation and standard error. Confidence limits for mean and proportion. Probability and Basic	15

	concepts: Normal and binomial distribution. Correlation and regression : Linear and multiple correlation and regression.	

IV	Test of Hypothesis: Null hypothesis, alternate hypothesis, test statistics, Type I and Type II errors, level of significance and critical region. Z test: for a single sample, two samples and two sample proportion. t-test a single sample, two samples and testing the significance of the correlation. Coefficient: t paired test, x^2 test: As a goodness of fit and in 2x2 contingency test. Introduction to ANOVA, one way ANOVA, repeated measures ANOVA, Friedman Test.	15

Course Outcome	
Learner will be able to	
CO1	Develop skilled bioinformatics professionals who have life science background
CO2	Proficiency in computational aspects.

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Bioinformatics and Functional Genomics	Pevsner	Wiley Blackwell		2015
2.	Bioinformatics:A practical Guide to analysis of genes & proteins	Baxevanis, Ouellette	Wiley-Interscience		2001
3.	Methods in Biostatistics	B.K. Mahajan	JP Medical	7th	2008
4.	Biostatistics	Wayne Daniel			

M. Sc (Biotechnology)		Semester – II	
Course Name: Bioinformatics & Biostatistics Practical		**Course Code: VGVPSBMBBP201**	
Periods per week (1 Period is 120 minutes)		**2**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Practical Examination**	3	**100**

List of Practicals

1. Using NCBI and Uniprot web resources
2. Introduction and use of various genome databases.
3. Sequence information resource: Using NCBI, EMBL, Genbank, Entrez, Swissprot/ TrEMBL, UniProt.
4. Similarity searches using tools like BLAST and interpretation of results.
5. Multiple sequence alignment using ClustalW.
6. Phylogenetic analysis of protein and nucleotide sequences.
7. Use of gene prediction methods (GRAIL, Genscan, Glimmer).
8. Using RNA structure prediction tools.
9. Use of various primer designing and restriction site prediction tools.
10. Use of different protein structure prediction databases (PDB, SCOP, CATH).
11. Measures of central tendency: Mean, median and mode for grouped and ungrouped data
12. Measures of dispersion: Standard deviation for grouped and ungrouped data: standard value for the mean and proportion.Confidence limits for the mean and proportion
13. Probability: Normal distribution and Binomial distribution use of normal tables
14. Correlation and Regression: Estimation of correlation coefficient, to fit regression equations from bivariate data
15. Test of hypothesis: a) Z-test, b) t-test c) x^2 test d) f-test

Course Outcome	
Learner will be able to	
CO1	To apply mathematical and statistical concepts in developing bioinformatic tools.
CO2	To know bioinformatics, its scope, importance and outreach.

M. Sc (Biotechnology)		Semester – II	
Course Name: Bioprocess Engineering & Technology		**Course Code: VGVPSBMBT201**	
Periods per week (1 Period is 60 minutes)		**4**	
Credits		**4**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2**	**60**
	Internal	**--**	**40**

Course Objective

Understand the basic skills applied in fermentation technology
Understand various aspects of bioprocess technology

Unit	Details	Lectures
I	**Sources of Microorganisms Used in Biotechnology**- Literature search and culture collection supply, Isolation de novo of organisms producing metabolites of economic importance. **Strain Improvement**- Selection from naturally occurring variants, Manipulation of the genome of industrial organisms in strain improvement **Bioreactor design and analysis** Media formulation and optimization methods; sterilization of bioreactors aeration and agitation in bioreactors KLa value (factors affecting and methods of determination), heat transfer in bioprocess measurement and control of bioprocess parameters. **Bioprocess economics**	15
II	**Principles of Microbial Growth** Batch Fermentation, Fed-Batch Fermentation Continuous Fermentation **Maximizing the Efficiency of the Fermentation Process** High-Density Cell Cultures, Increasing Plasmid Stability, Quiescent *E. coli* Cells, Protein Secretion and Reducing Acetate **Bioreactors** **Typical Large-Scale Fermentation Systems** Two-Stage Fermentation in Tandem Airlift Reactors, Two-Stage Fermentation in a Single Stirred-Tank Reactor, Batch versus Fed-Batch Fermentation **Harvesting Microbial Cells** **Disrupting Microbial Cells Downstream Processing** Protein Solubilization **Large-Scale Production of plasmid DNA**	15

III	**Introduction and scope** 1. Enzymes sourced from animals and plants used in food manufacturing technology 2. Enzyme usage in food applications. **Mechanism of enzyme function and reactions in food processes** 1 Starch-processing and related carbohydrates. 2. Lipases for the production of food components: interesterified fat 3. Enzymes in protein modification 4. Enzymes in bread making 5. Enzymes in dairy product manufacture 6. Enzymes in fruit and vegetable manufacture 7. Enzymes in fruit and vegetable processing 8. Beer production using immobilized cell technology	15
IV	1.Microbial biomass production: mushrooms, SCP 2. Fermented foods from: meat and fish, bread, Vegetables (sauerkraut, cucumber), Legumes and Oil Seeds soya bean fermentations 3. Beverages a) Stimulant Beverages-coffee, cocoa and tea fermentations b) Alcoholic beverages - Cider production 4.Food additives and supplements a) Lipids, Nucleosides, nucleotides and related compounds- Vitamins b) Natural food preservatives- bacteriocins from lactic acid bacteria – production and applications e.g. Nisin c) Microbial production of colours and flavours. d) Polyhydric alcohols: low-calorie sweetener particularly useful for sweetening food products for diabetics e) Microbial exopolysaccharides - Xanthan gum 5. Process Food wastes- for bioconversion to useful products (Compost, biofuels, biomass cheap source of raw material in fermentation).	15

Course Outcome	
Learner will be able to	
CO1	Understand principles underlaying design of fermentor and fermentation process.
CO2	Develop skills of handling industrially important microbes.

Books and References:					
Sr. No.	**Title**	**Author/s**	**Publisher**	**Edition**	**Year**
1.	Principles of fermentation technology	Stanbury Whitaker	Oxford Pergamon		2010
2.	Industrial Microbiology	Micheal Waites			

M. Sc (Biotechnology)		Semester – II	
Course Name: Bioprocess Engineering & Technology Practical.		**Course Code: VGVPSBMBTP201**	
Periods per week (1 Period is 120 minutes)		**2**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Practical Examination**	3	**100**

List of Practical:

1. Use of microorganism to produce a product. Detect utilization of substrate and formation of product at time intervals. Attempt purification of product e.g. enzyme.
2. Immobilize an organism / enzyme and detect the conversion of substrate to product.
3. Microbial pigment:
    a. production – factors affecting – pH, temp, nutrients, static/ shaker conditions, submerged/ surface.
    b. extraction – soluble and insoluble pigments- organic solvent extraction and purification.
4. Demonstration of media optimization by Placket Burman test- demonstration
5. Methods for measurement of cell mass:
    a. Direct physical measurement of dry weight, wet weight, or volume of cells after centrifugation.
    b. Indirect measurement of chemical activity such as nutrient utilization and product synthesized.
    c. Turbidity measurements employ a variety of instruments to determine the amount of light scattered by a suspension of cells.
6. Analytical techniques like HPLC, FPLC, GC, GC-MS *etc.* for measurement of amounts of products/substrates. Demonstration
7. Quality Assurance in a food industry – Field visit and report
8. Method validation for any biochemical test (Accuracy, Limit of Detection, Limit of Quantitation, Specificity, Linearity and range, Ruggedness and Robustness) – Report writing

M. Sc (Biotechnology)		Semester – II	
Course Name: Clinical Studies		**Course Code: VGVPSBMCS201**	
Periods per week (1 Period is 60 minutes)		**2**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2**	**60**
	Internal	**--**	**40**

Course Objective

The objective of this course is to have a firm foundation in Clinical Studies. To provide students knowledge about Clinical Trial design, Indian Regulations, and Clinical Data Science.

Unit	Details	Lectures
I	**Clinical Trial Design** • Basic framework of clinical trial • Randomized clinical trials anddifferent phases • Adaptive randomization methods • Seamless design • Internal pilot design Design selection factors **Regulations** • The national regulatory body • Key documents in clinical research **Regulatory requirements for theconduct of clinical trials in India** • Investigators, • Research institutions anduniversities Journals and Professional societies	15
II	**Clinical Data Science** • Data management in clinicalresearch: An overview • Data Sources and Data Types • Standards in Healthcare Data • Research Data Stewardship forHealthcare Professionals • Preparing Data for PredictionModel Development • Prediction Modeling Methodology Clinical Decision Support System **The Roles and Responsibilities of Stakeholders in the Sharing of Clinical Trial Data** Participants in clinical trials,	15

Course Outcome	
Learner will be able to	
CO1	Able to understand the clinical trial design set up.
CO2	To gain information on rules-regulation and responsibilities in clinical studies.

Books and References:					
Sr. No.	**Title**	**Author/s**	**Publisher**	**Edition**	**Year**
1.	Basic & Clinical Pharmacology	Gerard Marshall RajRamasamy Raveendran, Editors		14th	2017
2.	Clinical Trial Designs, Indian Dermatol Online J. 2019 Mar-Apr; 10(2): 193–201.	Brijesh Nair			2019

M. Sc (Biotechnology)		**Semester – II**	
Course Name: Biophysical & Biochemical Techniques		**Course Code: VGVPSBEL201**	
Periods per week (1 Period is 60 minutes)		**2**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2**	**60**
	Internal (Practical)	**--**	**40**

Course Objective
Learn various analytical techniques.

Unit	Details	Lectures
I	**Microscopic techniques** Confocal microscopy, Scanning Probe microscope, AFM, cryotomy scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freeze- fracture methods for EM, image processing methods in microscopy, single cell imaging.	15

II	**Spectroscopy**: Introduction and principle of: fluorescence spectroscopy, Light scattering spectroscopy, Luminometry, circular dichroism, NMR and ESR spectroscopy, Molecular structure determination using X-ray diffraction, X ray crystallography and NMR, Molecular analysis using light scattering, IR, Atomic absorption Spectroscopy.	15

Course Outcome	
Learner will be able to	
CO1	Use various bioanalytical techniques.
CO2	Understand the basis of instrumentation methods used for bioanalysis.

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Principles and Techniques of Biochemistry & Molecular Biology	Wilson & Walker	Cambridge Univ. Press	7th	2010
2.	Biophysics	Pattabhi & Gautam	Narosa Publishing House		2002

M. Sc (Biotechnology)		Semester – II	
Course Name: Biophysical & Biochemical Techniques Practical		**Course Code: VGVPSBELP201**	
Periods per week (1 Period is 120 minutes)		**2**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**(Internal) Practical Examination**	3	**40**

List of Practicals

1. Polymerase Chain Reaction
2. Separation of pigments using column chromatography.
3. Viscosity of Proteins
4. Demonstration and interpretation of NMR, HPLC,GC readouts.
5. Separation of sugars using TLC.
6. Use of affinity chromatography for purification ofantibodies from serum.

Technique based - Paper presentation.

M. Sc (Biotechnology)		Semester – II	
Course Name: Bioentrepreneurship		**Course Code: VGVPSBEL202**	
Periods per week (1 Period is 60 minutes)		**4**	
Credits		**4**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2**	**60**
	Internal	**--**	**40**

Unit	Details	Lectures
I	Concept of Entrepreneur; Entrepreneurship; Need and Importance; Factors Influencing Entrepreneurship; Essentials of a Successful Entrepreneur	15
II	Location of Enterprise; Real Estate and Human Resource Planning, Financial Planning; Role of Government and Financial Institutions in Entrepreneurship Development; Raising Money from Venture Capitalists, Government Grants, Product Selection and Ideas; Project Planning and Formulation; Project Feasibility Assessment; Regulatory Affairs, Corporate Laws, Innovation, IPR generation and Protection, Preparation of a Business Plan, Characteristics and Importance of Planning;	15

III	Marketing Plan for an Entrepreneur; Strategic Alliances, Advertising and Sales Promotion; Market Assessment, Need for International Market Research, Domestic *vs.* International Market Research, Cost and Methodology of Market Research, Desk and Field Research	15
IV	Presentation of Business Proposal for any Biotechnological Product/ Enterprise	15

The Kelkar Education Trust's

Vinayak Ganesh Vaze College of Arts, Science & Commerce, (AUTONOMOUS)

EXAMINATION PATTERN AND MARKING SCHEME- M.Sc IT/BT Semester-1

Exam	Major Course 1	Major Course 2	Major Course 3	Elective	RM	OJT /
Credits	4 Credits	4 Credits	4 Credits	2 T +2PCredits	4 credits	--
Internal	40 marks Class Test (15M) Assignment /Presentation (15M) APICID &Attendance (10M)	40 marks Class Test (15M) Assignment /Presentation 15M) APICID &Attendance (10M)	40 marks Class Test (15M) Assignment /Presentation (15M) APICID &Attendance (10M)	40 marks Class Test (15M) Assignment /Presentation (15M) APICID &Attendance (10M)	40 marks Class Test (15M) Assignment /Presentation (15M) APICID &Attendance (10M)	
External	60 marks 2 hours	60 marks 2 hours	60 marks 2 hours	60 marks 2 hours	60 marks 2 hours	
For Practical courses	2 credit 100 M		-	2 Credit (100 M)	-	---
Passing Standard	Combined passing 40% marks (40/100) subject to minimum 20% in Internal (8/40) and External evaluation (12/60)	Combined passing 40% marks (40/100) subject to minimum 20% in Internal (8/40) and External evaluation (12/60)	Combined passing 40% marks (40/100) subject to minimum 20% in Internal (8/40) and External evaluation	Combined passing 40% marks (40/100) subject to minimum 20% in Internal (8/40) and External evaluation	Combined passing 40% marks (40/100) subject to minimum 20% in Internal (8/40) and External evaluation	
Total	100 M	100 M + 100 M (P)	100 M	100 M+ 100 M (P)	100 M	
				Credits =22	**Grand Total 700**	

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EXAMINATION PATTERN AND MARKING SCHEME- M.Sc IT/BT Semester-2

Exam	Major Course 1	Major Course 2	Major Course 3	Elective	RM	OJT /
Credits	4 Credits	4 Credits	4 Credits	2 T +2PCredits		4 Credit
Internal	40 marks Class Test (15M) Assignment /Presentation (15M) APICID &Attendance (10M)	40 marks Class Test (15M) Assignment /Presentation 15M) APICID &Attendance (10M)	40 marks Class Test (15M) Assignment /Presentation (15M) APICID &Attendance (10M)	40 marks Class Test (15M) Assignment /Presentation (15M) APICID &Attendance (10M)		
External	60 marks 2 hours	60 marks 2 hours	60 marks 2 hours	60 marks 2 hours		Dissertation & presentation Viva 100 M
For Practical courses	2 credit 100 M		-	2 Credit (100 M)	-	---
Passing Standard	Combined passing 40% marks (40/100) subject to minimum 20% in Internal (8/40) and External evaluation (12/60)	Combined passing 40% marks (40/100) subject to minimum 20% in Internal (8/40) and External evaluation (12/60)	Combined passing 40% marks (40/100) subject to minimum 20% in Internal (8/40) and External evaluation	Combined passing 40% marks (40/100) subject to minimum 20% in Internal (8/40) and External evaluation		passing 40% marks (40/100)
Total	100 M	100 M + 100 M (P)	100 M	100 M+ 100 M (P)		100 M
			Credits =22	**Grand Total 700**		