SCHEME & SYLLABUS

M.Sc. Biotechnology

Department of Natural Sciences
UISH
Sant Baba Bhag Singh University
2017

INDEX

Course Scheme, M. Sc. Biotechnology (Semester-I-IV)

SEMESTER I

I. Theory Subjects

S.No	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credits Hours
1	BT501	Enzymology and Enzyme Technology	4:0:0	4:0:0	4	4
2	BT503	Molecular Biology	4:0:0	4:0:0	4	4
3	BT505	Tools and Techniques	4:0:0	4:0:0	4	4
4	BT507	Biochemistry	4:0:0	4:0:0	4	4
5	MAT515	Biostatistical Methods	3:0:0	3:0:0	3	3
6	BT509	Seminar-I	1:0:0	1:0:0	1	1

II. Practical Subjects

1	BT511	Biochemistry and Enzymology Practical	0:0:4	0:0:2	4	2
2	BT513	Minor Project Work	0:0:8	0:0:4	8	4
				Total	**32**	**26**

Total Contact Hours: 32
Total Credit Hours: 26

SEMESTER II

I. Theory Subjects

S.No	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credits Hours
1	BT502	Microbiology	4:0:0	4:0:0	4	4
2	BT504	Molecular Cell Biology	4:0:0	4:0:0	4	4
3	BT506	Immunology	4:0:0	4:0:0	4	4
4	BT508	Genetic Engineering	4:0:0	4:0:0	4	4
5	BT510	Biochemical and Biophysical Techniques	4:0:0	4:0:0	4	4
6	BT512	Seminar –II	1:0:0	1:0:0	1	1

II. Practical Subjects

1	BT514	Microbiology and Immunology Practical	0:0:4	0:0:2	4	2
2	BT516	Minor Project- II	0:0:8	0:0:4	8	4
				Total	**33**	**27**

Total Contact Hours: 33
Total Credit Hours: 27

SEMESTER III

I Theory Subjects

S.No	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credits Hours
1	BT601	Fermentation Technology	4:0:0	4:0:0	4	4
2	BT603	Bioinformatics & IPR	4:0:0	4:0:0	4	4
3	BT605	Animal Cell Culture	4:0:0	4:0:0	4	4
	Elective Course (any one of the following)					
4	BT607	Environment Biotechnology – I (Elective-1)	4:0:0	4:0:0	4	4
5	BT609	Plant Cell culture (Elective-2)	4:0:0	4:0:0	4	4
6	BT611	Food Biotechnology (Elective-3)	4:0:0	4:0:0	4	4
7	BT613	Seminar-III	1:0:0	1:0:0	1	1

II. Practical Subjects

1	BT615	Cell Culture and Fermentation Technology Practical	0:0:4	0:0:2	4	2
2	BT617	Minor Project-III	0:0:8	0:0:4	8	4
				Total	**29**	**23**

Total Contact hrs: 29

Total Credit Hours: 23

SEMESTER-IV

S. No	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credits Hours
1	BT602	Project Work (4 Months)	0:0:0	0:0:0	25.0	25.0

Total	**25.0**	**25.0**

Total Contact hrs: 25.0
Total Credit Hours: 25.0

Course Scheme Summary

Sem	L	T	P	Contact hrs/wk	Credits
1	21	0	6	32	26
2	21	0	6	33	27
3	17	0	6	29	23
4	0	0	25	25	25
Total	59	0	43	120	102

Total Contact hrs for I-IV semester: 119
Total Credit Hours for I-IV semester: 101

ENZYMOLOGY AND ENZYME TECHNOLOGY

Course Code	**BT501**
Course Title	**Enzymology and Enzyme Technology**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Any stream
Course Objective (CO)	The students will be acquainted with variety of roles of enzymes and their applications

UNIT-I

Enzymes (General Account): Classification of enzymes and enzyme kinetics of single substrate and two substrate catalyzed reactions; Factors affecting rate of enzymatic reactions: temperature pH modulators etc and significance of activation energy and free energy in biochemical reactions.

UNIT-II

Enzyme Cofactors and Mechanism of Enzyme Catalysis: Structure and biological function of a variety of enzyme cofactors. Enzyme substrate complex concept of ES complex binding sites, active site and type of enzyme specificities.

UNIT-III

Regulation of Enzyme activity: Covalent Modification & Allosteric Regulation, Isozymes and Apoenzymes

UNIT-IV

Enzyme immobilization and Biotransformation: Methods and principles, Supporting matrix, advantages,

Applications of enzyme technology in environment; Medical, Agricultural, Industrial benefit**s**

Text and Reference Books:

S. No	Name	Author(S)	Publisher
1.	Biochemistry.	Stryer	W.H.Freeman & Co
2.	Outline of Biochemistry.	Cohn and Stumph.	
3.	Enzymology and Enzyme Technology	Bhatt SM	S CHAND Publisher India
4.	Fundamentals of Biochemistry, J/W . 3rd Edition..	Voet & Voet Donald	John Wiley & Sons; 3 edition (March 9, 2004)
5.	Principles of Biochemistry	A.Lehninger	WH Freeman Publisher & Co.
6.	Biochemistry	Lubert Stryer.	WH Freeman Publisher

MOLECULAR BIOLOGY

Course Code	**BT503**
Course Title	**Molecular Biology**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Any stream
Course Objective (CO)	To provide basic and applied knowledge of Molecular biology mechanism suitable for research work.

UNIT-I

Organization of genetic materials: Various models to explain the structure of the nucleus and chromosomes, Special type of chromosomes: lamp brush, salivary and B chromosomes. Packaging of DNA as nucleosomes in eukaryotes, Genomic organization in prokaryotes and Archaebacteria

UNIT-II

DNA replication and repair: Enzymes & accessory proteins involved in DNA replication. Replication process in prokaryotic & Eukaryotic DNA.

DNA Repair:- Types of DNA Repair, Mechanism of DNA Repair

UNIT-III

Transcription: Importance of DNA binding Proteins, RNA polymerase; Mechanism of Transcription in prokaryotes & Eukaryotes; Processing of RNA:- m-RNA processing, 5' capping, 3' polyadenylation, splicing; r-RNA & t- RNA processing

UNIT-IV

Translation: The translation machinery, role of t RNA & ribosome; Mechanism, of translation; Post translational modification of proteins.

Text and Reference Books:

S. No	Name	Author(S)	Publisher
1.	Principles of genetics	Gardener, ,	Wiley Publications, 8th edition
2.	Gene VI to Gene VIII,	Levin,	Oxford Pub.
3.	Essentials of Molecular Biology,	Friefelder,	Panima Pub
4.	Fundamentals of Biochemistry, J/W . 3rd Edition..	Voet & Voet Donald	John Wiley & Sons; 3 edition (March 9, 2004)
5.	genes to clones ,	Winnacker	From Panima Pub.
6.	Gene Cloning and DNA analysis	Brown, ,	Blackwell Pub.

TOOLS AND TECHNIQUES

Course Code	**BT505**
Course Title	**Tools and Techniques**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Any stream
Course Objective	To give students knowledge about the different Instruments used in biological sciences and prepare them for research work.

UNIT-I

Microscopy, principle & applications of: Light microscope, phase contrast microscope and Fluorescence microscope; General principle and applications of Electron microscope (TEM & SEM); Principle and applications of Confocal microscopy; Cryotechniques: Cryopreservation of cells, tissues, organs and organisms, Freeze fracture & freeze drying

UNIT-II

Principles and applications of photometry: Beer & Lambert's law, Absorption spectrum & absorption maxima; Colorimeter & spectrophotometer; Flame photometer; Atomic absorption spectrophotometer

UNIT-III

Separation techniques: Chromatography, principle, types and applications; Electrophoresis, principle, types & applications, PAGE and agarose gel electrophoresis; Radioisotopes in biology: Units of radioactivity, Radioactive counters; Autoradiography

UNIT-IV

Histological techniques: Principles of tissue fixation, Microtomy, cryotomy; Immunological techniques: Immunodiffusion and Imunoelectrophoresis; Molecular cytological techniques: In situ hybridization (radiolabelled & non-radiolabelled methods), FISH, and Restriction banding; Molecular biology techniques: Southern hybridization and Northern hybridization; DNA sequencing; Polymerase chain reaction (PCR)

Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	Handbook of Microscopy	Locquin and Langeron	Butterwaths
2	Modern Experimental Biochemistry	Boyer	Benjamin
3	Practical Biochemistry	Wilson and Walker	Cambridge
4	Introduction to Instrumental analysis	Robert Braun	McGraw Hill Int.
5	Experimental Biochemistry	Clark & Switzer	Freeman Publ.

BIOCHEMISTRY

Course Code	**BT507**
Course Title	**Biochemistry**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Any stream
Course Objective (CO)	To study the classification, occurrence and structure of biomolecules and their metabolism. To study the general concept of nitrogen fixation and its role in plant growth and development.

UNIT-I

Carbohydrates: Classification, occurrence and structure of monosaccharides, oligosaccharides and polysaccharides (Starch, cellulose and pectin; Proteins: Amino acids, structure and characteristics, peptides and protein structure, functions of proteins; Conjugate proteins, Accounts of lactins and their function

UNIT-II

Lipids: Classification, occurrence, structure and importance of acryl lipids and phosphates; Concept of free energy and entropy, high energy compounds, Gibb's free enengy concept in biochemical reaction; Synthesis of ATP through oxidative electron transport chain, Chemiosmotic regeneration of ATP

UNIT-III

Gluconeogenesis vs glycolysis; Biosynthesis of fatty acids; Degradation of fatty acids; Lipid as high energy molecule; Role of Kreb's cycle

UNIT-IV

Nitrogen fixation by free living and symbiotic organisms, mechanism of nitrogen fixation, Soil nitrogen sources, nitrogen uptake by plants and assimilation; Nitrate reductase system, substrate controlled induction, interrelation between photosynthesis and nitrogen metabolism; Brief account of amino acid synthesis by reductive amination, GS-GOGAT system, transamination; Basic structure of impotant phenolics and alkaloids: a general view of their synthesis

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Biochemistry and Molecular Biology of Plants	Buchanan, B.B., Gruissem, W., and Jones, R.L. (2000).	American Society of Plant Physiologists, Maryland.
2	Lehninger Principles of Biochemistry: 6th Edition	Nelson, D. L., Cox, M.M	Macmillan Learning

BIOSTATISTICAL METHODS

Course Code	**MAT515**
Course Title	**Biostatistical Methods**
Type of course	Theory
L T P	3 0 0
Credits	3
Course prerequisite	B.Sc. Any stream
Course Objective	To learn general concept of Biostatistics

UNIT-I

Data collection, tabulation, Frequency distribution and its graphical representation
Measures of Central tendency: mean, mode, median
Measures of Dispersion: range, variance, Standard deviation and Standard error

UNIT-II

Mathematical definition of a probability event; Conditional probability
Additive and Multiple law of Probability;Theoretical Distributions: Binomial, Poisson and Normal

UNIT-III

Null Hypothesis and Level of Significance; Confidence limit and confidence interval Skewness and Kurtosis moments; Student's t- test (Paired and Unpaired); Chi Square tests

UNIT-IV

Correlation: Covariance, Karl pearson's correlation coefficient and Spearmans rank correlation coefficient; Regression: Least square technique for regression lines, regression coefficient; Relation between Correlation and Regression; Analysis of variance(one way and two way ANOVA)

Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	Introduction to Mathematics for Life Scientists	Batschelet, E	Springer-Verlag, Berlin
2	Mathematical Biology	Murray, J.D.	Springer-Verlag, Berlin
3	Statistical Methods	Snedecor&Cochran	Affliated East-West Press
4	Biostatistics	P. Ramakrishnan	Saras Publications
5	Biostatistics: Basic Concepts and Methodology for the Health Sciences	Wayne W. Daniel	Wiley Publication

BIOCHEMISTRY AND ENZYMOLOGY PRACTICAL

Course Code	**BT511**
Course Title	**Biochemistry and Enzymology Practical**
Type of course	Theory
L T P	4 0 0
Credits	2
Course prerequisite	B.Sc. Any stream
Course Objective (CO)	To be acquainted with common practical's used in research

LIST OF EXPERIMENTS

1. Estimation of Protein by Folin Lowry methods
2. Method of Carbohydrate Estimation (any one)
   - **I)** Estimation of reducing sugar by DNSA method.
   - **II)** Estimation of Carbohydrate by Phenol Sulphuric acid Method.
3. Analysis of oils, iodine numbers, saponification value, acid number
4. Enzyme assay, Enzyme Kinetics
5. To calculate specific activity of enzymes
6. Determination of Km & Vmax of ezymes
7. Determination of optimum pH,
8. To determine optimum temperature of Amylase/Alkaline phosphatase /protease/ cellulase

Text /Reference Book:

S. No	Name	Author(S)	Publisher
1.	Introduction to Practical Biochemistry	Plummer Mu, David T. Plummer	Tata McGraw-Hill Education, 1988

MICROBIOLOGY

Course Code	**BT502**
Course Title	**Microbiology**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. any stream
Course Objective (CO)	To make acquainted students about basics and applied microbiology useful in Industrial products

UNIT-I

Methods in Microbiology: Sterilization Methods, Pure culture technique, Enrichment techniques; Preservation & Maintenance of culture; Staining & fixation, Bacterial morphology; Growth curve of bacteria, Measurement of microbial growth, The influence of environmental factors in growth; Synchronous growth, Continuous growth; Sporulation, Spore germination; Common Nutrient requirements, Types of media for growth of microorganisms.

UNIT-II

Medical Microbiology and epidemiology: Pathogenicity and virulence.Virulence factors of microorganism; Epidemiology

UNIT-III

Bacterial Genetics: Recombination of bacterial genes, gene targeting; Gene transfer method; Transformation, Conjugation & Transduction; Mutation:- Types , causes & effects of mutation

UNIT-IV

Viruses & Prions: General Characteristics of viruses; **Viruses of Bacteria** Lytic & Lysogeny cycle: General features, RNA & DNA viruses); **Viruses of Plants:-** Different types of plant, viruses , mechanism of infection; **Animal viruses:-** General features of retroviruses, overview of Animal viruses, HIV and AIDS: Prions & Molecular basis of their pathogenecity

Text /Reference Book:

S. No	Name	Author(S)	Publisher
1	Microbiology, 5th Edition,	Pelczar Jr., M J, Chan, E C S and Krieg, N R	McGraw-Hill
2	Microbiology, 6^{th} Edition	Prescott L. M.	Brown Publishers
3	Principles Of Microbiology, 2Nd Edition Paperback – 2015	by R.M. Atlas (Author)	Mc Graw Hill India

MOLECULAR CELL BIOLOGY

Course Code	**BT504**
Course Title	**Molecular Cell Biology**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Any stream
Course Objective (CO)	To be acquainted with basic and advance course in cell biology

UNIT-I

Cell cycle & Cell signaling: Overview of cell cycle & It's control; Components of Cell Cycle control systems; Role of Protein kinase in cell cycle; Check points in Cell Cycle regulation; Signaling through G-Proteins linked cell surface receptors, signaling through Enzyme linked cell surface receptors.

UNIT-II

Cytoskeleton: Microtubules, cilia, flagella & centrioles, roles of microtubule dynamics in cell division; Microfilaments & cell motility; Intermediate filaments; Actin & Myosin, Functional role of actins filaments and motor proteins; The cytoskeleton & cell behavior.

UNIT-III

Developmental Biology and Cell Differentiation: Establishing multicellularity, formation of blastula, embryonic germ layer, tracking of migrating cells; Aggregation behavior in embryonic cells and possible understanding in the positional information in developing organs; Roles of different proteins in fertilization

UNIT-IV

Molecular Biology of Cancer: Characteristics of cancer cells; The genetic basis of cancer, Proto-oncogenes & its regulation; Oncogenes & cancer, Viral oncogenes (Viruses & Cancer); Techniques used in cancer research (From genomics to proteomics); Cancer treatment present & future; Regulation of gene expression and signal translocation on cancerous cells vs. Normal cells

Text and Reference Books:

S. No	Name	Author(S)	Publisher
1.	Microbiology5th Edition,	Pelczar Jr., M J, Chan, E C S and Krieg, N R	McGraw-Hill
2.	General Microbiology. Fifth Edition	Roger Y. Stanier, John Lgraham, Mark L Wheelis, Rage R Painter	Published by Macmillan, Hampshire & London
3.	Microbiology, 6^{th} Edition	Prescott L. M.	Published by Wm. C. Brown Publishers
4.	Principles Of Microbiology, 2Nd Edition Paperback	by R.M. Atlas (Author)	Mc Graw Hill India; 2nd edition (2015)

IMMUNOLOGY

Course Code	**BT506**
Course Title	**IMMUNOLOGY**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Any stream
Course Objective (CO)	To provide knowledge of Immune technology for research

UNIT-I

Molecular cells & organs of Immune system:Historical perspective, Innate Immunity:- Skin, Mucosal Surface, Physiological barrier, Inflammation, Adaptive Immunity Molecules of innate & Acquired immune system:- Complement, Interferon, other molecules Cells of Innate & Acquired Immune System Organs of the immune system: Primary Lymphoid organs, Secondary Lymphoid organs, Lymphatic etc.

UNIT-II

Antigens, Antibody & Ag-Ab Interaction: Antigens: - Immunogenicity vs Antigenicity, Factors influencing Immunogenicity, Adjuvant, Epitopes & Haptens, super antigens, auto antigens; Antibody:- Structure, classes & functions, Allotypes & Idiotypes; Basic principles of Antigen-Antibody Interaction; Immunological techniques: Principles & Applications: Precipitation & agglutination, Radio Immunoassay, Enzyme linked Immunosorbent Assay etc.

UNIT-III

Mechanism of Immune response: Generation of Immunological diversity; Antigen recognition; Lymphocyte development and activation; Lymphocyte interaction, cytokines & lymphoid system.

UNIT-4:

MHC & Transplantation Immunology: MHC:- General organization, MHC molecules & genes; Cell recognition of self & nonself, MHC restriction , Tolerance:- Central Peripheral & acquired tolerance, HLA typing methods using serological and molecular techniques.

Text and Reference Book:

S. No	Name	Author(S)	Publisher
1.	Immunology, 5th Edition	Janis Kuby,	W.H.Freeman & Co Ltd; 3rd Revised edition edition (16 April 1997)
2.	Essential Immunology, 9th Edn.	Ivan M. Roitt	Blackwell Science, Inc.
3.	Handbook of Human Immunology,	Mary S. Leffell,& Noel R. Rose,	CRC press

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GENETIC ENGINEERING

Course Code	**BT508**
Course Title	**Genetic Engineering**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Any stream
Course Objective (CO)	To provide practical exposure in Genetics engineering technology for research

UNIT-I

Molecular Tools used in Genetic Engineering: Restriction Endonuclease and Restriction mapping DNA modifying enzymes:- Nuclease, Polymerase, Enzymes that modify the ends of DNA molecules, DNA ligase- joining DNA Molecules; Adaptors, Linkers, Homopolymer tailing

UNIT-II

Gene cloning vectors: Plasmids, Cosmids, Bacteriophage; Phagemids, BAC,YAC; Shuttle vector, Expression Vector & other Advanced vectors

UNIT-III

Cloning Strategies: Genomic libraries, Preparation of DNA fragments for cloning; Positional cloning, chromosome walking, Jumping; C-DNA Synthesis & cloning; *In-vitro* phage packaging; Probe preparation (Radiolabelled & non-radiolabelled)

UNIT-IV

Selection, Screening & analysis of recombinant: Genetic selection of screening methods:- Use of hromatographic substrate, Insertional inactivation, Complementation of defined mutation; Methods based on nucleic acid homology (Southern, Northern, Western Blotting, Subtractive, colony & plaque hybridization, chromosomal walk; *In-situ* chromosomal hybridization, Immunological screening for expressed genome; Microarray Technique,

Text and Reference Books:

S. No	Name	Author(S)	Publisher
1.	Gene Cloning and DNA Analysis	T A Brown	Blackwell
2.	From Genes to Genomes: Concepts and Applications of DNA Technology, 3rd Edition	Jeremy W. Dale, Malcolm von Schantz, Nicholas Plant	Wiley
3.	From genes to clones introduction to gene technology	by Ernst L. Winnacker	John Wiley

BIOCHEMICAL AND BIOPHYSICAL TECHNIQUES

Course Code	**BT510**
Course Title	**Biochemical and Biophysical Techniques**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Any stream
Course Objective (CO)	To give students knowledge about the different Instruments used in biological sciences and prepare them for research work.

UNIT-I

Radioisotope Techniques and Microscopy: Radioisotopes & half- life of isotopes, Units & measurement of radiation, Autoradiography, Application of radioisotopes in biological study, Electron Microscopy: Transmission, EM & Scanning EM, Flow Cytometry

UNIT-II

Spectroscopy: Spectroscopic techniques:- Beer Lambert's law, Extinction coefficient, Principles & applications of visible & U.V. spectroscopic technique; Absorption & Emission Spectroscopy; X-ray diffraction & crystallization; CD, ORD, IR & NMR, MALDI-TOF Mass spectroscopy (Matric Assisted Laser; Desorption Ionization Time of Flight Mass Spectrometry

UNIT-III

Chromatography: Chromatography Theory & Principles; Key terms: Stationary phase, mobile phase, Retention time, column efficiency, Peak shape, Rate theory; Types of chromatography, partition, adsorption, Ion exchange, size exclusion, affinity, Paper chromatography, Hydrophobic chromatography, GC,GLC, HPLC

UNIT-IV

Centrifugation and Electrophoresis: Centrifugation: - Sedimentation, Relative centrifugal force, preparative and analytical centrifuge. Basic Principles of electrophoresis, Agarose electrophoresis, PAGE, SDS PAGE, 2D PAGE, Isoelectrofocussing; Polymerase Chain Reaction; DNA markers:- RFLP, micro-minisatellites, SNPs, RAPDs,AFLP, Linkage analysis, genotyping; & DNA fingerprinting

Text and Reference Books:

S. No	Name	Author(S)	Publisher
1.	Analysis of Amino Acids, Proteins and Nucleic Acids	Biotol,	B.H.Edn.
2.	Techniques used in Bioproduct Analysis,	Biotol,	B.H.Edn.
3.	Basic Biophysics. Student Edn.	Daniel,	
4.	Biophysics,	Singh,	Freeman Pub.
5	Principles and Practices in Bioanalysis,	Richard F. Ven,	Taylor & Francis Inc.
6	Practical Biochemistry,	Wilson & Walker,	Cambridge Edn.

MICROBIOLOGY AND IMMUNOLOGY PRACTICAL

Course Code	**BT514**
Course Title	**Microbiology and Immunology Practical**
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. Any stream
Course Objective (CO)	To gain practical exposure of Microbiology

LIST OF EXPERIMENTS

1. Isolation and maintenance of organism by plating, streaking & serial isolation methods slants & stab culture, storage of microorganism
2. Microscopic observation - Gram staining, Capsule & Spore Staining
3. Growth cure – Diauxic
4. Effect of Environmental Factors on Growth of Bacteria: Salt, Temp, pH.
5. Viable count of bacteria from soil sample (Dilution Plating Method)
6. Biochemical characterization of selected Microbes
7. Isolation of bacteriophages from sewage sample
8. Enrichment and Isolation of:

a) Halophiles b) Acidophiles c) Phenol Degraders d) Nitrogen Fixers e) Antibiotic Producers f) Kojic Acid Producers

9. Alcohol Fermentation
10. Comparative studies of ethanol production using different substrates
11. Immobilization of Whole Cells
12. Effect of Antibiotics on various Gram Positive and Gram Negative bacteria
13. Determination of Minimum Inhibitory Concentration (MIC) and Minimum
14. Bactericidal Concentration (MBC) of various Antibiotics on different Organisms

Text and reference books:

S. No	Name	Author(S)	Publisher
1.	Laboratory Experiments in Microbiology,6th Edition	Jhonson	Pearson Education
2.	A Laboratory Manual,8th Edition	Cuppuccino,Microbiology	Benjamin Cummings; 7 edition (April 5, 2004)

FERMENTATION TECHNOLOGY

Course Code	**BT601**
Course Title	**Fermentation Technology**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Any stream
Course Objective (CO)	To be acquainted with Basic of fermenters used in Industrial Biotechnology

UNIT-I

Basics of fermentation: Introduction to fermentation Media for fermenters, Isolation and screening of industrially useful microorganisms; Strain improvement, Metabolites: Primary and Secondary, Computer application in fermentation technology.

UNIT-II

Design of fermenter: Various Design and types of fermentors & Bioreactor; Aeration and agitation, valves and gates, Foam control; Batch, fed-batch and continuous culture operations; Feedback System, Achievement and Maintenance of aseptic conditions, Fermentors in Animal Culture.

UNIT-III

Product Recovery & Purification (Downstream Processing): Extraction and separation techniques; Cell disruption – disintegration, Flocculation & Floatation, Filtration, Centrifugation, Distillation; Enrichment of product by: Thermal process, Membrane filtration and dialysis, Freeze concentration, Chromatographic methods, Purification: Crystallization, Whole Broth Processing

UNIT-IV

Industrial production of chemicals: Alcohol Fermentation; Vitamins (Vit. B12); Amino acids (Lysine & Glutamic acid); Antibiotics (Penicillin & streptomycin); Enzyme (Amylase, Protease).

Text and Reference Books:

S. No	Name	Author(S)	Publisher
1.	Principles Of Fermentation Technology Paperback – 2008	by P F Stanbury Dr. A Whitaker (Author)	Elsevier; 2 edition (2008)
2.	Bioprocess Engineering Principles Paperback – 2009	by Pauli. M (Author)	Elsevier (2009)
3.	Bioprocess Engineering Principles Paperback – 2012 by Doran (Author)		Elsevier; Second edition (2012)

BIOINFORMATICS & IPR

Course Code	**BT603**
Course Title	**Bioinformatics & IPR (Intellectual Property Rights)**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Any stream
Course Objective (CO)	To learn application of Bioinformatics tools in Biotechnology

UNIT-I

Introduction: Bioinformatics and its relation with molecular biology. Examples of related tools (FASTA, BLAST, BLAT, RASMOL), databases (GENBANK, Pubmed, PDB). and software (PHYLIP).

Data generation; Gene Sequencing, Protein sequencing, 2 D Gel electrophoresis, Microarray.

UNIT-II

Sequence Alignments and Phylogeny: Introduction to Sequences, alignments and Dynamic Programming; Local alignment and Global alignment (algorithm and example), Pairwise alignment and multiple sequence alignment (Clustal W algorithm). Introduction to phylogenetics.

UNIT-III

Intellectual property: Intellectual property rights (IPR) (Patents, trade secret, copy right, trade marks), Choice of intellectual property protection (IPP). IPR and plant genetic resources (PGR). TRIPS agreement.

UNIT-IV

Patent Impringement: Types of impringement, Indusrtial Designs, Geographical Indications, Protection of Trade Secrets,

Patenting of Biological Materials: International conventions. International cooperation obligations with patent applications, implications of patenting, current issues: Can live form be patented-?

Text and Reference Books:

S. No	Name	Author(S)	Publisher
1.	Evolutionary Computation in Bioinformatics,	Gary B.Fogel & David Corne,	Morgan Kaufmann Publishers,
2.	Bioinformatics : Sequence and Genome Analysis, Laboratory Press	David W. Mount,	Cold Spring Harbor

ANIMAL CELL CULTURE

Course Code	**BT 605**
Course Title	**Animal Cell Culture**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Any stream
Course Objective (CO)	To learn basics of Plant and animal tissue culture and its related applications

Syllabus

UNIT I

Introduction, importance, history of cell culture development: different tissue culture techniques including primary and secondary culture, continuous cell lines, suspension culture, organ culture etc.

UNIT II

Different type of cell culture media: growth supplements, serum free media, balanced salt solution, other cell culture reagents, culture of different tissues and its application.

UNIT III

Behavior of cells in culture conditions: division, their growth pattern, metabolism of estimation of cell number.

UNIT IV

Development of cell lines: characterization and maintenance of cell lines, stem cells, cryopreservation, common cell culture contaminants.

Text and Reference Books:

S. No	Name	Author(S)	Publisher
1.	Culture of Animal Cells, 5th Edition,	Freshney,	Wiley-Liss, 2005
2.	Animal Cell Culture: Concept And Application Paperback – 8 Jul 2011	by S. M. Bhatt (Author)	Narosa Publishing House (8 July 2011)

ENVIRONMENTAL BIOTECHNOLOGY – I

Course Code	**BT607**
Course Title	**Environmental Biotechnology – I**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Any stream
Course Objective (CO)	To learn about Industrial effluents toxicity and methods of bioconversions

UNIT-I

Environmental impact and Biosensors: Reducing environmental impact of industrial effluents Toxic site reclamation, removal of spilled oil and grease deposits. Microbial degradation of textile dyes, timber petroleum products, leather plastics and food product; Biosensors, recent approaches and applications

UNIT-II

Bio fertilizers: Use of mycorrhizae in reforestation and aforestation; Biofertilizers and biopesticides; Role of *Dienococcus sp.* in bioremediation of radioactive waste. Molecular mechanisms of radiation resistant

UNIT-III

Environment and energy: Renewable source of energy: Biomass production and Biogas production. Generation of energy and fuel using microorganisms (Hydrogen production and Methane production); Brief account of alternative energy source: Biofuel etc. Conservation of energy: Global Warming and carbon credit; Heavy metals and its effect on microbes and higher organisms

UNIT-IV

Biodiversity: Biodiversity & species concept; Benefits from Biodiversity; Factors threatening Biodiversity; Endangered species management & Biodiversity protection

Text and Reference Books:

S. No	Name	Author(S)	Publisher
1.	Environmental Biochemistry,	Rajvaidhya,	APH Pub
2.	Industrial & Envi. Biotech,	Ahmed,	Horizon
3.	Wastewater Microbiology - 2 ed,	Bitton,	Wiley
4.	Environmental Microbiotech	D.P.Singh,	, New Age

PLANT CELL CULTURE

Course Code	**BT609**
Course Title	**PLANT CELL CULTURE**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Any stream
Course Objective (CO)	To learn basics of plant tissue culture and its related applications

UNIT-I

Introduction: Introductory history, scope and application of plant biotechnology. Plant Cell and tissue culture media, plant growth regulators in tissue culture their use and preparation. Cellular totipotency, Cytodifferentiation and morphogenesis

UNIT-II

Initiation of aseptic culture techniques, single cell and cell suspension culture, callus culture, protoplast culture and somatic hybridization. *In vitro* and *in vivo* pollination and fertilization, embryo culture and embryo rescue, somatic embryogenesis, artificial seeds. Doubled haploid production through distant hybridization, Androgenesis (anther and pollen culture) and Gynogenesis (ovary and ovule culture)

UNIT-III

***In vitro* clonal propagation** and large scale production of plants through micropropagation - Prospects and problems, meristem tip culture, shot tip culture and shoot tip grafting. Production of useful bio-chemical substances through tissue culture system, Scale-up through Bio-reactors, Bioinsecticides, biopesticides

UNIT-IV

Transgenic plant and their production Preservation of plant genetic resources: Germplasm collection and conservation, Designing and erection of polutunnels, greenhouses. Acclimatization and hardening of micropropagated plants.

Text /Reference Book:

S. No	Name	Author(S)	Publisher
1.	Plant Tissue Culture by	MK Razdan & SS Bhojwani (1996)	Elsevier

FOOD BIOTECHNOLOGY

Course Code	**BT611**
Course Title	**Food Biotechnology**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Any stream
Course Objective (CO)	To make aware of students about role of microbes in food biotechnology

UNIT-I

Culture Media: Starter cultures and their biochemical activities; production of alcoholic beverages; production of Single cell protein and Baker's yeast; Mushroom cultivation; Food and dairy products: Cheese, bread and yogurt; Fermented vegetables – Saurkraut; Fermented Meat – Sausages

UNIT-II

Novel microorganisms: LAB (Probiotics), Cyanobacteria, methylotrophs enzyme; iotransformations; Role of Plant tissue culture for improvement of food additives; color and flavor; Genetic modifications of microorganisms; detection and rapid diagnosis genetically modified foods and crop

UNIT-III

Food borne infections and intoxications: with examples of infective and toxic types – Clostridium, Salmonella, Staphylococcus; Mycotoxins in food with reference to Aspergillus species; Food preservation: canning, dehydration, ultrafiltration, sterilization, irradiation; Chemical and naturally occurring antimicrobials; Biosensors in food industry.

UNIT-IV

Quality assurance: Microbiological quality standards of food; Intellectual property rights and animal welfare; Government regulatory practices and policies. FDA, EPA, HACCP, ISI Risk analysis; consumer and industry perceptions.

Text and Reference Books:

S. No	Name	Author(S)	Publisher
1.	Food Biotechnology, Volume 17 1st Edition	S. Bielecki J. Polak J. Tramper	Elsevier Science 2000
2.	Food Biotechnology First Edition Edition	Vinod K. Joshi (Author), R. S. Singh (Author)	I K International Publishing House; First Edition edition (March 10, 2012)

CELL CULTURE AND FERMENTATION TECHNOLOGY PRACTICAL

Course Code	**BT615**
Course Title	**Cell Culture and Fermentation Technology Practical**
Type of course	Theory
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. Any stream
Course Objective (CO)	To make aware of students about practical aspects of biotechnology

LIST OF EXPERIMENTS

1. Setup of a plant tissue culture lab
2. Media preparation and its components
3. Callus induction
4. Explant preparation
5. Micro propagation of Rose
6. Anther Culture
7. Protoplast Fusion and isolation
8. Dismantling and identification of the various components of the fermentor and study the various systems making up the fermentor.
9. Cleaning, assembling and sterilization of fermetor.
10. Microbial production of citric acid using Aspergillus niger.
11. Isolation and study of fungus responsible for food spoilage.
12. Comparative study of ethanol production using different substrates.

Text and Reference Books:

S. No	Name	Author(S)	Publisher
1.	Principles Of Fermentation Technology Paperback – 2008	by P F Stanbury Dr. A Whitaker (Author)	Elsevier
2.	Bioprocess Engineering Principles Paperback – 2009	by Pauli. M (Author)	Elsevier
3.	Culture of Animal Cells, 5th Edition	Freshney,	Wiley-Liss

PROJECT WORK/ DISSERTATION

Course Code	**BT602**
Course Title	Project Work/ Dissertation
Type of course	Practical
L T P	0 0 25
Credits	25
Course prerequisite	B.Sc Any stream
Course Objective (CO)	The students will undergo 4 months training to learn about latest techniques used in research

GUIDELINE TO CARRY OUT PROJECTWORK

1. **Purpose of Project Work:** The main purpose of Project Work is to make the students familiar with Research Methodology i.e. reference work, experimental work, statistical analysis of experimental data, interpretation of results obtained, writing of dissertation and powerpoint presentation of Project work. This will not only help train the inquisitive minds of the students, but also inspire them to take up research- oriented higher studies and career.

2. Duration of Project work:-

Development on the nature of the research problem and the infrastructure available in the Respective Biochemistry/Microbiology Departments or Research Institutes or Industries, the recommended duration of Project Work is 05 months.

3. Nature of Research Project:-

The following will be considered as the Research Project.

a. Experimental based involving laboratory analytical work, or

b. Survey based Field work with statistical analysis of data collected, or

c. Industrial training based provided that the candidate has undergone actual hands on Training in instrumental analytical techniques.

4. Submission of project Work:-

a. After completion of Project each student should prepare a PowerPoint presentation to be delivered to the respective department committee.

b. The committee should conduct comprehensive viva-voce of the students.

c. The final copy of the dissertation will have to submit to the respective department.