MASTER OF SCIENCE (BIOTECHNOLOGY)

REGULATIONS

ELIGIBILITY

A Bachelor's degree in Science, with Biotechnology/ Botany/ Zoology/ Biology/ Microbiology/ Microbial Gene technology/ Bioinstrumentation/ Bioinformatics/ Biochemistry/Chemistry/Agriculture/Marine Biology/Home Science/Farm Science/ Nutrition and Dietetics/Integrated Biology/Plant Science/Animal Science/Fisheries Science/Agriculture /Mathematics with Physics, Chemistry as Ancillary/Medical Lab Technology MBBS/BDS, B.Pharm and BSMS of a recognized Indian or Foreign University.

DURATION OF THE COURSE:

The duration of the course is TWO academic years divided into four semesters under Choice Based Credit System.

OBJECTIVES OF THE COURSE

- The two year M.Sc., program is designed to help the student to be the pioneering and resourceful personalities in the field of life science.
- The ultimate aim is to enable the students to develop an interdepartmental approach for understanding the life science problems at the molecular level. In addition, the present curriculum gives scope for vertical and horizontal mobility in the education system so that the students can enter different modules to update their knowledge depending upon the employment opportunities in each area.
- Various IDC and practical courses have been designed not only to enable the students to appreciate scientific basis of various life processes but also to train them for self-employment. The practical training will develop their reasoning ability to critically evaluate the results obtained from the projects.
- The present curriculum aimed to cater the global demand for skilled and trained manpower in various areas like Research and Development, Quality control labs, Industries, Biopharmaceutical companies and in field of teaching.
- The curriculum has also have its module to explore the students entrepreneurial skill and help them to become a successful entrepreneur.

SCHEME OF EXAMINATION

Subject Code	Subject	Hours of Instruction	Exam Duration (Hours)	Maximum Marks			Credit Points
				CA	CE	Total	
First Semester							
			Part A				
15PBTM101	Core I: Principles of Cell Biology	4	3	25	75	100	4
15PBTM102	Core II: Principles of Genetics	5	3	25	75	100	5
15PBTM103	Core III: Principles of Microbiology	5	3	25	75	100	5
15PBTM104	Core IV: Biochemistry	5	3	25	75	100	5
15PBTM105	Core V: Bioinstrumentation and Bioinformatics	4	3	25	75	100	4
15PBTMP101	Core Practical I	6	9 (6+3)	40	60	100	3
			Non Credit				
15PLS101	Career competency Skills I	1	-	-	-	-	-
		30				**600**	**26**
Second Semester							
			Part A				
15PBTM201	Core VI: Molecular Biology	5	3	25	75	100	5
15PBTM202	Core VII: Bioprocess Technology	5	3	25	75	100	5
15PBTM203	Core VIII: Immunotechnology	5	3	25	75	100	5
15PBTM204	Core IX: Environmental Biotechnology	4	3	25	75	100	4
15PBTMP201	Core Practical II	3	6	40	60	100	3
Optional Subjects							
15PBCBTI201	IDC I: Diagnostic Biochemistry	3	3	25	75	100	3
15PBCBTIP201	IDC Practical I: Diagnostic Biochemistry	2	3	40	60	100	2
15PMBBTI201	IDC I: Fundamentals of Microbiology And Clinical Microbiology	3	3	25	75	100	3
15PMBBTIP201	IDC Practical I: Fundamentals of Microbiology And Clinical Microbiology	2	3	40	60	100	2

Part B							
15PVE201	Value Education: Human Rights	2	3	25	75	100	2
Non Credit							
15PLS201	Career competency Skills II	1	-	-	-	-	-
		30				**800**	**29**
Third Semester							
Part A							
15PBTM301	Core X: Plant and Animal Tissue Culture Technology	5	3	25	75	100	5
15PBTM302	Core XI: Advances in rDNA technology and Bioethics	5	3	25	75	100	5
15PBTM303	Core XII: Food and Pharmaceutical Biotechnology	4	3	25	75	100	4
15PBTM304	Core XIII: Biostatistics and Research Methodology (100% Internal Evaluation)	4	3	100	-	100	4
15PBTMP301	Core Practical III	4	6	40	60	100	3
	Elective	3	3	25	75	100	3
Optional Subjects							
15PBCBTI301	IDC II: Pharmaceutical Biochemistry	3	3	25	75	100	3
15PBCBTIP301	IDC Practical II: Pharmaceutical Biochemistry	2	3	40	60	100	2
15PMBBTI301	IDC II: Industrial Microbiology	3	3	25	75	100	3
15PMBBTIP301	IDC Practical II: Industrial Microbiology	2	3	40	60	100	2
		30				**800**	**29**
Fourth Semester							
Part A							
15PBTM401	Core XIV: Corporate Biotechnology (Self-study and External evaluation)	-	3	-	100	100	5

15PBTPR401	Dissertation &Viva-Voce	-	-	50	150	200	8
						300	**13**
					Grand Total	**2500**	**97**

LIST OF ELECTIVE

The students shall select any one of the following elective subject in third semester.

S.NO	SUBJECT CODE	SUBJECT	SEMESTER
1	15PBTEL301	Computational Biology	III
2	15PBTEL302	Down Stream Processing	III
3	15PBTEL303	DNA Cloning	III

CERTIFICATE COURSE

Students shall undergo a Certificate course in Third semester which carries 100 marks.

S.NO	CERTIFICATE COURSE	SEMESTER	HOURS
1	Mushroom cultivation	III	50

FOR COURSE COMPLETION

- Students shall undergo a Certificate course in Third semester.
- Students shall complete one Value Education in Second semester.
- Students shall opt any one Elective course in Third semester.

TOTAL CREDIT DISTRIBUTION

S.NO	PART	COMPONENTS	TOTAL NUMBER OF SUBJECTS	MAXIMUM MARKS	TOTAL MARKS	CREDIT POINTS
1.	PART - A	Core Subjects	14	100	1400	65
		Core Practical	3	100	300	09
		IDC Paper	2	100	200	06
		IDC Practical	2	100	200	04
		Elective Subject	1	100	100	03
		Project	1	200	200	08
2.	PART - B	Value Education	1	100	100	02
				TOTAL	**2500**	**97**

15PBTM101	CORE I: PRINCIPLES OF CELL BIOLOGY	SEMESTER – I

Total Hours: 50

OBJECTIVE:

1. To learn the basics about Cell biology and Cell communication.

CONTENTS

UNIT – I **(10 Hours)**

Cell Theory, Emergence of modern cell biology. Structure of Prokaryotic and Eukaryotic cells, Structure and functions of Cell wall and Plasma membrane.

UNIT - II **(10 Hours)**

Cell Organelles and their functions - Mitochondria, Endoplasmic reticulum, plastids, chloroplast, Golgi apparatus, vacuoles, peroxisomes (glyoxysomes), Nucleus, Chromosomes- giant chromosomes, lysosome and ribosomes. Biogenesis of mitochondria and chloroplast.

UNIT – III **(10 Hours)**

Cytoskeleton: Microtubules, microfilaments and intermediate filaments.
The extra cellular matrix and cell interaction- The extracellular space, interaction of cells with extracellular materials and other cells, Tight junction and gap junction, plasmo desmata.

UNIT – IV **(10 Hours)**

Cell signaling: Signaling molecule and cell surface receptor, Intracellular signal transduction, G protein coupled receptors mediated: activation of adenyl cyclase, regulation of ion channel, activation of phospholipase C, activation of gene transcription.

UNIT – V **(10 Hours)**

Cell cycle control and cell death: Overview of cell cycle, cell cycle control system, Cell division – Mitosis, meiosis and cytokinesis. Cell death and renewal – Programmed cell death (Apoptosis) and its regulation. Stem cells – proliferation and differentiation.

REFERENCE BOOKS:

1. *Gerald Karp*., 2010. **Cell Biology**. [Sixth Edition]. John wiley and Sons (Asia) Pvt. Ltd.
2. *Sadava, D.E.,* 2004. **Cell Biology: Organelle Structure and Function.** Reprint, [First Edition]. Panima Publishing Corp., India.
3. *Geoffrey M. Cooper and Hausman, R.E*., 2007. **The Cell - A Molecular Approach**. [Fourth Edition]. ASM Press, Washington, D.C.
4. *Lodish Berk, Kaiser Krieger, Scott Bretscher, Ploegh* and *Matsudair*. 2011. **Molecular cell Biology**. [Fifth Edition]. W. H. Freeman and Company, New York.
5. *Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts and Peter Walter.* 2007. **Molecular Biology of the Cell.** [Fourth Edition]. Garland Science, Taylor and Francis Group.

15PBTM102	CORE II: PRINCIPLES OF GENETICS	SEMESTER - I

Total Hours: 50

OBJECTIVE:

1. To understand the basic concept of genes and its inheritance.

CONTENTS

UNIT – I **(8 Hours)**

Basic concepts, branches, scope and importance of genetics. Mendelian genetics:- Mendel's experiments, principles of segregation, dominance, recessiveness and codominance. Principles of Independent Assortment, Dihybrid and Trihybrid ratios, Epistasis and Multiple alleles.

UNIT – II **(8 Hours)**

Molecular genetics: Experimental evidence of DNA and RNA as a genetic material, Transformation, Hershey Chase experiment, Structure of DNA- Watson and Crick double helical model, forms of DNA.

UNIT – III **(10 Hours)**

Population genetics: Genetic variation, the Hardy Weinberg law, Inbreeding, Outbreeding and Assertive mating, Changes in allele frequency- Mutation, migration, selection, and random genetic drift.

UNIT-IV **(12 Hours)**

Changes in Chromosome number and structure: Euploidy - Dominan traits (Achondroplasia and Huntington's disease), Recessive traits (Albinism and cystic fibrosis), Trisomy- Down syndrome, Turner's syndrome, Klinefelter syndrome.

UNIT-V **(12 Hours)**

Evolution genetics: Natural selection, Molecular evolution- Neutrality, Phylogenetic trees, Use of mt-DNA in studying genetic relationships.
Development of Unicellular organism - Yeast. Multicellular organism – *Caenorabditis elegans*, *Arabidopsis thaliana*.

REFERENCE BOOKS:

1. *Peter J. Russell.* 2006. **Genetics A Molecular Approach.** [Second Edition]. Benjamin Cummings, New York.
2. *Weaver R.F.* and *Hedrick P.W.* 1995. **Basic genetics** [Second Edition]. Wm.C.Brown Publishers.
3. *Lewis.* 2004. **Human genetics - Concepts and Applications**. [Sixth Edition]. WCB Mc Graw Hill, New York, USA.
4. *Peter Snustad* and *Michael J. Simmons*. 2000. **Principles of Genetics**. [Second Edition]. John Wiley and Sons, Inc. New York.
5. *Williams. S. Klug and Michael. R. Cummings*, 2004. **Concepts of Genetics.** [Seventh Edition]. Pearson Sons Education, (Singapore) Pvt. Ltd., Indian Branch, Delhi.
6. *Lewin,B.* 2008.***Genes* IX**. Jones and Bartelett Publishers, London.
7. *Tamarin R H*., 2007. **Principles of Genetics.** [Seventh Edition]. The McGraw Hill.

15PBTM103	CORE III: PRINCIPLES OF MICROBIOLOGY	SEMESTER - I

Total Hours: 55

OBJECTIVE:

1. To understand the basic concepts of microbiology.

CONTENTS

UNIT – I **(9 Hours)**

Origin and evolution of Microbiology: Contributions of Antony van Leeuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner and Alexander Fleming. Microbial evolution – three Kingdom and five Kingdom concepts. Microbial Classification and Taxonomy, Taxonomic Ranks, Techniques in Taxonomy, Assessing phylogeny.

UNIT – II **(10 Hours)**

Microbial growth: Culture media – Complex and defined media – Nutrient media, differential media, selective media, enrichment media, minimal media. Sterilization: Types – physical and chemical methods. Aseptic techniques, Culture methods – Pure culture techniques – Streak plate and Spread Plate methods. Anaerobic culture techniques. Determination of generation time and growth curve.

UNIT – III **(14 Hours)**

Microscopy: Light Microscope - Bright Field, Dark field, phase contrast, fluorescent and confocal scanning laser. Electron Microscope – Transmission Electron Microscope, Scanning Electron Microscope, Sample preparation for electron microscopy. Stains and Staining reactions, Types of staining: Simple staining, Differential Staining - Gram's, Acid-fast, Endospore and Capsular staining. Microscopic measurement of microorganisms – Micrometry.

UNIT – IV **(10 Hours)**

Clinical significance of Microorganisms: Virulence factors of pathogens – Host-parasite interactions – Microbial pathogenicity, normal microflora and nosocomial infections in human. Antimicrobial chemotherapy – Antibiotics – Classification and mode of action. Antimicrobial susceptibility testing, Quality control in Microbiology.

UNIT – V **(12 Hours)**

Classification of Archaebacteria, eubacteria (including Cyanobacteria), Algae, Fungi and Viruses. Nature, special features of the thermophilic, methanogenic and halophilic Archaea; Culture Collection Centers and International Depository Authorities.

REFERENCE BOOKS:

1. *Prescott L.M., Harley, J.P. and Klein, D.A*. 2005. **Microbiology**. [Seventh Edition]. Tata McGraw Hill Publishing Company, USA.
2. *Ronald M. Atlas,* 1997. **Principles of Microbiology** [Second Edition]. McGraw hill Publication.
3. *Jacquelin Black*. 2000. **Microbiology: Principles and Explorations**. [Sixth Edition]. John Wiley & Sons publication.
4. *Salle, A.J.* 1986. **Principles of Bacteriology**. [Seventh Edition]. Tata McGraw-Hill Publishing Company Ltd., New Delhi.
5. *Anantha Narayanan, R. and Panikar, CKJ.* 2002. **Microbiology**. [Sixth Edition]. Orient Longman Pvt. Ltd., New Delhi.
6. *Madigan, M.T. Martinko, JM. and Parker, J.* 2007. **Brock Biology of Microorganisms**. [Eleventh Edition]. Pearson Prentice Hall, USA.

15PBTM104	CORE IV: BIOCHEMISTRY	SEMESTER - I

Total Hours: 55

OBJECTIVE:

1. To learn the fundamentals of Biomolecules and its function in living system.

CONTENTS

UNIT – I **(10 Hours)**

Biochemistry – Definition, Carbohydrates: – Definition and Classification – Monosaccharides, Disaccharides and Polysaccharides, structure and properties of Monosaccharides, Isomers, Epimers, Enantiomers and Anomers, structure, source and function of disaccharides and polysaccharides.

UNIT – II **(12 Hours)**

Amino acids: – Classification and structure, Proteins: - structure and classification, Lipids – classification, Nucleic acids – structure of nitrogenous bases, nucleotides and nucleosides.

UNIT – III **(11 Hours)**

Concepts of Metabolism
Catabolism: Glycolysis – reactions and energy yield of Glycolysis, Beta oxidation of Fatty acids, TCA cycle, Electron Transport Chain and Oxidative Phosphorylation.
Anabolism: Gluconeogenesis, Cholesterol biosynthesis, De novo and Salvage pathway of Purine and Pyrimidine biosynthesis.

UNIT – IV **(10 Hours)**

Enzymes – Nomenclature, classification, properties, factors affecting enzyme activity- substrate concentration, temperature, and pH, Inhibition of enzyme activity – competitive, noncompetitive, and uncompetitive. Michaelis - Menten equation.

UNIT – V **(12 Hours)**

Vitamins- Fat soluble and water soluble vitamins, Hormones - Definition, classification, biological functions and disorders of Pituitary hormone (Growth hormone), Thyroid hormone, Adrenal hormone (adrenaline), Pancreatic hormone (insulin).

REFERENCE BOOKS:

1. *Nelson D. L.,* and *Cox, M. M.,* 2008. **Lehninger Principles of Biochemistry.** [Fourth Edition]. W. H. Freeman and Company, New York.
2. *Champe, P. C.* and *Harvey, R. A.* 1994. **Biochemistry, Lippincott Illustrated Reviews.** [Second Edition]. Lippincott – Raven Publishers.
3. *Voet. D.* and *Voet, J.G.* 2011. **Biochemistry**. [Fourth Edition]. John Wiley & Sons (Asia) Pvt. Ltd.,
4. *Berg, J.M., John, L. T. and Stryer, L.* 2007. **Biochemistry**. [Sixth Edition]. W. H. Freeman and Company.
5. *Koolman, J. and Roehm, K. H.* 2005. **Color Atlas of Biochemistry**. [Second Edition]. Thieme Stuttgart, New York.

15PBTM105	CORE V: BIOINSTRUMENTATION AND BIOINFORMATICS	SEMESTER - I

Total Hours: 50

OBJECTIVES:

1. To understand the basic concept about Bioinstrumentation.
2. To understand the basics in Bioinformatics

CONTENTS

UNIT – I **(10 Hours)**

Introduction to Bioinstrumentation, care and maintenance of Weighing Balance, Incubators, Hot plate, Magnetic stirrer, Hot air oven, Laminar airflow and pH meter. Centrifugation Methods -Sedimentation, Centrifugation – rotor, motor, types of centrifuges- low and high speed, ultra centrifuges, Types of centrifugation – Analytical and Preparative.

UNIT – II **(10 Hours)**

Principles, Techniques and applications of Paper, Gel, SDS PAGE Electrophoresis, Isoelectric focusing, Immunoelectrophoresis, Capillary electrophoresis. Separation Techniques - Principles, Techniques and applications of Paper Chromatography, TLC, GLC, Ion exchange Chromatography, Gel Permeation Chromatography, Affinity Chromatography, Hydrophobic interaction chromotography.

UNIT – III **(10 Hours)**

Beer Lambert's law - Principles, Techniques and biological applications of Colorimeter, UV – VIS Spectroscopy, IR And Raman Spectroscopy, Atomic Absorption Spectroscopy, Flame Photometry, Spectrofluorometer.

UNIT – IV **(10 Hours)**

Bioinformatics – Basics, Applications. Biological Database – Classification, scheme, GENBANK, SwissProt and PDB. Sequence Alignment – Concept of Alignment, Pairwise Alignment: Principle, methods and Alignment with BLAST.

UNIT – V **(10 Hours)**

Gene Prediction – Overview, Prokaryotic features for gene prediction, prediction with GENSCAN. Molecular Phylogeny – Molecular Clock Hypothesis, Neighbour Joining method, mechanism and representation of Phylogeny, tree types.

REFERENCE BOOKS:

1. *Boyer.R.F.* 1993. **Modern Experiments in Biochemistry**. [Second Edition]. Benjamin/ Cummings Publishing Company, Red wood City, California.
2. *Upadhyay*, 2005. **Biophysical Chemistry**, Himalaya Publications.
3. Wilson. K. and Walker. 2003, **Practical Biochemistry**. [First Edition]. Cambridge University Press.
4. *David, J.H. and Hazel Peck.* 1998. **Analytical Biochemistry**. [Third Edition]. Prentice Hall an Imprint of Pearson Education.
5. *Zhumur Gosh and Bibekanand Mallick. 2008.* **Bioinformatics Principles and Applications.** Oxford University Press.
6. *David W. Mount.* 2004. **Bioinformatics: Sequence and Genome Analysis**. Cold Spring Harbor laboratory.

15PBTMP101	CORE PRACTICAL - I	SEMESTER - I

LIST OF EXPERIMENT

Cell biology, Microbiology, Genetics, Biochemistry and Bioinformatics

1. Introduction to Laboratory Guidelines and Laboratory Safety
2. Operation and Maintenance of Microscope
3. Preparation of Flow Chart from a Standard Procedure
4. Micrometry-Measurement of Cell Size (Yeast, Bacteria)
5. Mitosis
6. Meiosis
7. Observation of BGA – wet mount preparation
8. Preparation of media for microbiology
9. Enumeration and Isolation of bacteria from soil sample.
10. Staining: Gram's, Endospore and Acid Fast.
11. Bacterial Motility by Hanging-drop method
12. Biochemical test for identification of bacteria
    a) IMViC test
    b) Oxidase test
    c) Catalase test
    d) Triple Sugar Iron test
13. Staining of fungal elements – Lactophenol Cotton Blue mounting
14. Antimicrobial Susceptibility testing – Kirby-Bauer Diffusion Method
15. Determination of Growth Curve by turbidity method (temperature optimization)
16. Preparation of Buffer and calibration of pH meter
17. Estimation of Glucose in fruit (DNS method)
18. Estimation of DNA (Diphenyl amine)
19. Extraction and estimation of starch from potato
20. Identification of amino acids by Thin-layer chromatography method
21. Extraction of Genomic DNA (Spool-out method)
22. Estimation of DNA using spectrophotometer
23. Induced mutagenesis (UV and NTG)
24. Isolation of mutants by Gradient plate methods (Streptomycin)
25. Bioinformatics practical
    a. GENBANK database analysis.
    b. Swiss Prot analysis.
    c. Pairwise sequence alignment using BLAST program.

REFERENCE BOOKS:

1. *Joseph Sambrook and David W. Russell*, 2001. **Molecular cloning – A laboratory manual Volume 1 to 3**. [Third Edition]. Cold Spring Harbor Laboratory Press, New York.
2. Aneja, K.R. 2003. **Experiments in Microbiology, Plant pathology and Biotechnology.** [Fourth Edition]. New age international.
3. *Cappucino, J.G and Sherman, N.* 2012. **Microbiology – A laboratory manual.** [Seventh Edition]. Pearson Education Inc.
4. *Andreas D Baxevanis* and *B F Francis.* 2002. **Bioinformatics- A Practical Guide to Analysis of Genes & Proteins**. John Wiley Publications.
5. *David W Mount. 2004*. **Bioinformatics: Sequence and Genome Analysis**. CSHL
6. *Harold Varley*. 1988. **Practical Biochemistry,** Volume I & II. [Fourth Edition]. CBS Publishers, New Delhi.
7. *Janarthanan,S. and Vincent,S.*2009. **Practical Biotechnology: Methods and Protocols.** [Second Edition]. Universities press, (India) Pvt Ltd, Hyderabad.

15PLS101	CAREER COMPETENCY SKILLS I	SEMESTER – I

Total Hours: 15

OBJECTIVE:

To enhance employability skills and to develop career competency

CONTENTS

UNIT – I **(3 Hours)**

Solving Simultaneous Equations Faster - Number System: HCF, LCM - Decimals – Percentages- Averages

UNIT – II **(3 Hours)**

Powers and Roots -Problems on Trains- Problem on ages-Boats and Streams

UNIT – III **(3 Hours)**

Calendar-Clocks -Pipes and cisterns-Permutations and Combinations-Seating Arrangements

UNIT – IV **(3 Hours)**

Syllogism – Assertion and Reasons – Statements and Assumptions – Identifying Valid Inferences – Identifying strong arguments and weak arguments – Statements and Conclusions.

UNIT – V **(3 Hours)**

Reading comprehension – Self Introduction – News Paper Review – Book Review

15PBTM201	CORE VI: MOLECULAR BIOLOGY	SEMESTER - II

Total Hours: 50

OBJECTIVE:

1. To understand the molecular mechanism of cells.

CONTENTS

UNIT – I **(10 Hours)**

Molecular basis of life – an introduction. The structure of DNA and RNA. Chemical structure of nucleic acids- Nucleotides and Nucleosides, central dogma of molecular biology. Replication of DNA – Chemistry of DNA synthesis, Mechanisms of DNA polymerase, Replication fork, Initiation, elongation and termination of DNA replication.

UNIT – II **(10 Hours)**

The Mutability and repair of DNA. Replication errors and their repair, DNA Damage, Repair of DNA damage - DNA repair mechanism – Excision repair, recombination repair, and SOS repair. Recombination – Models for Homologous recombination and Holliday model, site-specific recombination and transposition.

UNIT – III **(10 Hours)**

Transcription – in prokaryotes – RNA polymerase and promoters. Transcription in Eukaryotes – RNA polymerase, promoters, enhancers and silencer. Mechanism of Transcription- initiation, elongation and termination. Post transcriptional modifications-capping, poly adenylation and splicing. Translation –Messenger RNA, Transfer RNA, Ribosome, Initiation, elongation and termination of translation. The Genetic code, Wobble hypothesis.

UNIT – IV **(10 Hours)**

RNA splicing – Chemistry of RNA splicing, spliceosome machinery, splicing pathway, Alternative splicing, Exon shuffling, RNA editing, mRNA transport. Post translational modification, protein targeting to various cellular organelles.

UNIT – V **(10 Hours)**

Gene regulation – Eukaryotes –Activators, Transcriptional repressors - Prokaryotes – The operon concept: lac and trp. Molecular events in Lambda life cycle- The decision between lytic and lysogenic cycle.

REFERENCE BOOKS:

1. *Peter Snustad, D. and Michael J. Simmon*, 2000. **Principles of Genetics.** [Second Edition]. John Wiley and Sons Publication.
2. *Peter, J. Russell*, 1997. **Genetics.** [Fifth Edition]. Benjamin – Cummings Publishing Company.
3. *Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Matthew P. Scott, Anthony Bretscher, Hidde Ploegh, Paul Matsudaira*, 2007. **Molecular Cell Biology.** [Fifth Edition]. W.H. Freeman and Company. New York.
4. *Robert F. Weaver*, 1999. **Molecular Biology.** [First Edition]. Mc Graw Hill Publication Company, USA.
5. *Williams. S. Klug and Michael. R. Cummings*, 2004. **Concepts of Genetics**. [Seventh Edition]. Pearson Sons Education (Singapore) Pvt. Ltd., Indian Branch, Delhi.

15PBTM202	CORE VII: BIOPROCESS TECHNOLOGY	SEMESTER - II

Total Hours: 50

OBJECTIVE:

1. To learn about the various bioprocess and engineering technology and to implement in Industries.

CONTENTS

UNIT – I **(10 Hours)**

Isolation of industrially important microbes. Primary and secondary screening and assay of fermentation products. Preservation of important strains. Improvement of the strain for increased yield and other desirable characters. An overview of aerobic and anaerobic fermentation process. Fermentation: Submerged and solid state fermentation and Immobilization.

UNIT – II **(10 Hours)**

Medium for Industrial Fermentations: Medium formulation, Optimization, Growth kinetics. Thermal death kinetics, Batch and continuous sterilization system. Sterilization of air. Reactor engineering – Bioreactor configuration – Stirred tank, Air lift, Bubble column, Packed beds.

UNIT – III **(10 Hours)**

Mass transfer – Introduction to mass transfer between phases, Gas – liquid mass transfer in cellular system, liquid – solid mass transfer, liquid – liquid mass transfer. Oxygen transfer – introduction, Oxygen transfer process and oxygen uptake. Determination of oxygen transfer co-efficient. Biological heat transfer. Heat transfer co-efficient.

UNIT – IV **(10 Hours)**

Bioprocess control and monitoring: Methods of measuring process variables such as Temperature, Agitation, Pressure, pH and foam. Online measurement, Control system: Manual and automatic control, On/Off controls and PID Control. Computer application in Fermentation technology.

UNIT – V **(10 Hours)**

Separation of microbial cells and suspended solids. Intracellular products recovery: Cell disruption – Physical and chemical method, Ultrafilteration, Centrifugation, Membrane process, Chromatography- HPLC, Column chromatography, Ion exchange and Affinity chromatography. Electrophoresis, Solvent extraction, Distillation, Crystallization, Evaporation and drying.

REFERENCE BOOKS:

1. *Stanbury. P.R and Whitaker,* 2002. **Principles of Fermentation Technology**. Elsevier Science Ltd.
2. *Pauline M. Doran*. 1995. **Bioprocess Engineering Principles**. Academic Press.
3. *Shuler M.L. and Kargi, F*. 2004. **Bioprocess Engineering: Basic Concepts.** [Second Edition] Prentice Hall. Pvt. Ltd., New Delhi.
4. *Crueger, W., Crueger, A*. 2002. **A Text Book of Industrial Microbiology**. [Second Edition]. Science Tech Publishers, USA.
5. *Patel, A.H*. 2005. **Industrial Microbiology.** [Fifth Edition]. Mac Millan India Ltd., New Delhi.

15PBTM203	CORE VIII: IMMUNOTECHNOLOGY	SEMESTER - II

Total Hours: 50

OBJECTIVE:

1. To understand the basic principles of immunology and molecular mechanisms.

CONTENTS

UNIT – I **(10 Hours)**

History and scope of immunology, Immune response - types & mechanisms, haematopoiesis. Cells & Organs of immune system and their role in immunity. Antigens – Antigenicity & Immunogenicity, Haptens, Adjuvants, Epitope.

UNIT – II **(12 Hours)**

Immunoglobulins: Basic structure, classes and biological activities. Antigenic determinants on immunoglobulin. Organization and expression of immunoglobulin genes – variable gene rearrangements, mechanism of rearrangements. Generation of Antibody diversity. MHC organization and structure, Antigen Processing and presentation; Cytosolic and Endocytic pathway. Complement proteins and pathways.

UNIT – III **(10 Hours)**

Cell mediated immune response – T cell maturation, activation and differentiation, Cytokines; properties, types and receptors. Humoral immune response – B cell generation, activation & differentiation. Primary and Secondary humoral immune response. Leukocyte migration - Cell adhesion molecules, Neutrophil extravasation, Lymphocyte extravasation.

UNIT – IV **(10 Hours)**

Hypersensitivity reactions, Immunodeficiency- Primary and Secondary immunodeficiency. Autoimmunity- Organ specific and Systemic autoimmunity. Transplantation- Immunological aspects of graft rejection - Cancer immunology- Cancer induction, Tumor antigen immune response to tumors. Vaccines, types and vaccination.

UNIT – V **(8 Hours)**

Antigen – antibody interaction; Agglutination, Precipitation, Immunoelectrophoresis, ELISA, Western blot, Immunofluorescence. Hybridoma technology, FACs, HLA typing.

REFERENCE BOOKS:

1. *Kuby Richard. A. Goldsby, Thomas. J. Kint* and *Barbara. A. Osborne.* 2000. **Immunology** [Fourth Edition]. W.H. Freeman and Company, New York.
2. *Peter J. Delves, Seamus J. Martin, Dennis R. Burton and Ivan M. Roitt***.** 2006. **Roitt's Essential Immunology**. [Eleventh Edition]. Blackwell Publication.
3. *Tristram G. Parslow, Daniel P. Stites, Abba I.Terr and John B. Imboden*. 2001. **Medical Immunology.** [Tenth Edition]. Tata Mc Graw Hill Publication.
4. *Ian Tizard, K.* 1995. **Immunology: An Introduction.** [Fourth Edition] Saunders College Publication.
5. *Kalus D. Elgert,* 2009**. Immunology - Understanding the Immune System.** [Second Edition]. Wiley-Blackwell Publication.
6. *Kenneth Murphy, Paul Travers and Mark Walport,* 2008. **Janeway's Immunobiology. [**Seventh Edition]. Garland Science Taylor and Francis Group, New York.

15PBTM204	CORE IX: ENVIRONMENTAL BIOTECHNOLOGY	SEMESTER - II

Total Hours: 50

OBJECTIVE:

1. To know about environment and to get knowledge about applications of biotechnology to protect and to develop our environment.

CONTENTS

UNIT – I **(10 Hours)**

Basic concepts and issues, Environmental pollution – air, water and soil, its control measures. Ozone depletion, UV-B, green-house effect and acid rain, their impact and biotechnological approaches for management, impact of chemicals and biological warfare agents on environment. Methodology of environmental management.

UNIT – II **(10 Hours)**

Aerobic System -Biological processes for domestic and industrial waste water treatments; Activated sludge process, Trickling filters, Biological filters, Rotating biological contractors, Fluidized bed reactor, Expanded bed reactor, Inverse fluidized bed biofilm reactor, Packed bed reactors, Air- sparged reactors, Anaerobic System-Anaerobic biological treatment - Contact digesters, Packed column reactors, UASB.

UNIT – III **(10 Hours)**

Introduction, constraints and priorities of Bioremediation, Biostimulation of Naturally occurring microbial activities, Bioaugmentation, *in situ, ex situ*, intrinsic & engineered bioremediation, Solid phase bioremediation - land farming, prepared beds, soiL piles, Phytoremediation. Composting, Bioventing & Biosparging; Liquid phase
bioremediation - Suspended bioreactors, Fixed biofilm reactors. Bioremediation of oil contaminated soil and water.

UNIT – IV **(10 Hours)**

Microbial transformation, accumulation and concentration of metals, metal leaching, extraction and future prospects. Microorganisms and energy requirements of mankind; Production of nonconventional fuels - Methane (Biogas), Hydrogen, Alcohols and algal hydrocarbons,Use of microorganisms in augmentation of petroleum recovery. CO_2 sequestration through plant.

UNIT – V **(10 Hours)**

Introduction - Xenobiotic compounds, recalcitrance. Biodegradation of Xenobiotics. Biological detoxification - market for hazardous waste management, biotechnology application to hazardous waste management - examples of biotechnological applications to hazardous waste management – cyanide detoxification - detoxification of oxalate, urea and
toxic organics like phenols.

REFERENCE BOOKS:

1. *Wesley, W. and Eckenfelder, J.R.* 2000. **Industrial Water Pollution Control**. [Third Edition]. Mc Graw – Hill Higher Education.
2. *Martin Alexander*, 1999. **Biodegradation & Bioremediation**. Academic Press.
3. *Ronald. L. Crawford and Don L. Crawford*, 1998. **Bioremediation Principles and Application.** [First Edition]. Cambridge University Press.
4. *Rao, C.S.* 1999. **Environmental Pollution Control Engineering.** [First Edition]. New Age International (P) Limited, New Delhi.
5. *Atlas and Bartha.* 1998. **Microbiol ecology.** [Fourth Edition]. Benjamin Science Publishing (P) Ltd.
6. *Indu Shekhar Thakur.* 2011. **Environmental Biotechnology- Basic concepts and applications** [Second Edition]. I.K. International Publishing House Pvt Ltd.
7. *Pradipa Kumar Mahapatra.* 2006. **Textbook of Environmental Biotechnology.** [First Edition]. I.K. International Publishing House Pvt Ltd.

15PBTMP201	CORE PRACTICAL II	SEMESTER - II

LIST OF EXPERIMENT

Molecular Biology, Bioprocess Technology, Immunology, Environmental Biotechnology.

1. Enzyme production using fermenter (Amylase/ Protease)
2. Cell disruption
3. Purification of protein by ammonium sulphate precipitation
4. Salting-out by Dialysis method
5. Estimation of protein by Lowry and Bradford methods
6. SDS – PAGE
7. Immobilization of enzyme
8. Wine production using Immobilization of yeast cells
9. Estimation of alcohol by potassium dichromate method
10. Citric acid production by solid state fermentation
11. ABO grouping
12. WIDAL Test (Slide and Tube methods)
13. Antigen-Antibody interaction
    a. Ouchterlony Double Diffusion
    b. Radial Immunodiffusion
    c. Immunoelectrophoresis
    d. Rocket Immunoelectrophoresis
    e. Counter Current Immunoelectrophoresis
14. Enzyme Linked Immunosorbent Assay (ELISA)
15. Western Blotting (protein gel transfer)
16. Water quality analysis (MPN test)
17. Biological Oxygen Demand
18. Chemical Oxygen Demand

REFERENCE BOOKS:

1. *Joseph Sambrook and David W. Russell*, 2001. **Molecular cloning – A laboratory manual Volume 1 to 3**. [Third Edition]. Cold Spring Harbor Laboratory Press, New York.
2. Aneja, K.R. 2003. **Experiments in Microbiology, Plant pathology and Biotechnology.** [Fourth Edition]. New age international.
3. *Cappucino, J.G and Sherman, N.* 2012. **Microbiology – A laboratory manual.**

[Seventh Edition]. Pearson Education Inc.

4. *Ramnik Sood*. 2006. **Medical Laboratory Technology**. Jaypee Brothers Medical Publishers Ltd., New Delhi.
5. *Janarthanan,S. and Vincent,S.*2009. **Practical Biotechnology: Methods and Protocols.** [Second Edition]. Universities press, (India) Pvt Ltd, Hyderabad.

15PBCMBI201/ 15PBCBTI201	INTERDISCIPLINARY COURSE I: DIAGNOSTIC BIOCHEMISTRY	SEMESTER – II

Total Hours: 38

OBJECTIVE:

1. To enable the students to develop practical and interpretative skills to contribute effectively in diagnostic haematology and clinical biochemistry.

CONTENTS

UNIT- I **(8 Hours)**

Clinical Laboratory: Introduction, types and set-up. Basic laboratory safety, hazards in the clinical laboratory, safety with chemical/reagents, first aid in laboratory accidents. SI units. Universal work precautions for lab personnels. Medical laboratories in the developing countries Fundamental chemistry - Indicators, solutes, solvents and solutions. Percentage, molar and normal solution with simple biochemical calculations.

UNIT- II **(6 Hours)**

Clinical Haematology: Ways of obtaining blood, Anticoagulants, Blood collection system, estimation of haemoglobin- Sahli's and Cyanmethaemoglobin method, packed cell volume and erythrocyte sedimentation rate, blood cell counts – WBC and RBC. Blood film examination, stain preparation and staining, rapid diagnostics – automation in haematology, bleeding time, clotting time.

UNIT- III **(8 Hours)**

Urine analysis and Stool examination: Physicochemical characteristics of urine, preservation of specimen, gross examination of urine and chemical examination of urine- mechanism of proteinuria, micro albuminuria, tests for glucose, ketone bodies, bile salts, bile pigments. Hereditary of carbohydrate metabolism. Stool examination – Specimen collection, test for occult blood, preparation and sample collection, microscopic examination of stool.

UNT- IV **(8 Hours)**

Clinical Chemistry and Enzymology: Diabetes Mellitus - Introduction, screening tests, diagnostic tests, insulin tolerance test. Estimation of glucose in blood, GTT,

glycosylated haemoglobin. Cardiovascular disease - Estimation of cholesterol, urea, creatinine and protein. Enzymology - Alkaline and acid phosphatase.

UNIT- V **(8 Hours)**

Organ function tests: Liver function test: Tests based on abnormalities of bile pigments, classification of jaundice. Renal Function: function of the kidney, dilution test, phenol red test, clearance test, principles of precise tests of renal function – Glomerular filtration rate, renal plasma flow and maximal tubular capacity.

TEXT BOOKS:

1. *Ramnik Sood.* 2006. **Medical Laboratory Technology.** [First Edition]. Jaypee Brother's Medical Publishers Ltd., New Delhi.
2. *Kanai L. Mukherjee.* 2005. **Medical Laboratory Technology, Volume I.** Tata McGraw- Hill Publishing Co. New Delhi.

15PBCMBIP201/ 15PBCBTIP201	INTERDISCIPLINARY COURSE PRACTICAL I: DIAGNOSTIC BIOCHEMISTRY	SEMESTER - II

LIST OF EXPERIMENT

1. **Clinical haematology**
   Enumeration of WBC and RBC.
   Estimation of haemoglobin (Sahli's method).
   Erythrocyte sedimentation rate (Westergren's method).

2. **Blood analysis**
   Estimation of glucose in blood (Nelson Somogyi's method).
   Estimation of urea in blood (DAM method).
   Estimation of creatinine in blood (Jaffe's method).

3. **Urine analysis**
   Estimation of creatinine in urine (Jaffe's method).
   Qualitative analysis of normal and abnormal constituents in urine.

REFERENCE BOOK:

1. *Harold Varley*. 1980. **Practical Biochemistry. Volume I & II.** [Fifth Edition]. CBS Publishers, New Delhi .

15PMBBTI201/ 15PMBBCI201	INTER DISCIPLINARY COURSE I : FUNDAMENTALS OF MICROBIOLOGY AND CLINICAL MICROBIOLOGY	SEMESTER - II

Total hours: 50

OBJECTIVES:

To familiarize the students with:

1. Basics in Microbiology
2. Basics in Microbial techniques.

CONTENTS

UNIT – I **(10 Hours)**

Definition and scope of Microbiology – Sterilization – Principles – dry heat and moist heat – radiation – filtration – chemical agents. Antibiotics – Mode of Action - Penicillin.

UNIT – II **(10 Hours)**

Media preparation – Liquid media, solid media, enriched media and differential medium. Pure culture techniques – Pour Plate, Streak Plate and Spread Plate techniques. Staining techniques – Gram's, Ziehl-Neelsen, Spore and Capsule staining.

UNIT – III **(10 Hours)**

Collection, transportation and processing of clinical specimens. Host parasite relationship – Normal flora. Morphology, culture, biochemical, pathogenicity, lab diagnosis and control of *Staphylococcus aureus* and *Escherichia coli*.

UNIT – IV **(10 Hours)**

General characteristic features of Fungi. Epidemiology, pathogenicity, lab diagnosis and treatment of Candidosis. General characteristic features of Protozoa. Pathogenicity, clinical manifestation and diagnosis of *Entamoeba histolytica*.

UNIT – V **(10 Hours)**

General characteristic features of viruses, cultivation of viruses. Properties, pathogenicity, diagnosis and treatment of Hepatitis virus A and B.

TEXT BOOKS:

1. *Ananthanarayan, R. and Jayaram Paniker, C.K.* 2007. **Text Book of Microbiology**. [Seventh Edition]. Orient Longman Ltd., Chennai.
2. *Lansing M Prescott, John P Harley and Donald A Klein.* 2007. **Microbiology**. [Seventh Edition]. Mc Graw Hill, New York.

REFERENCE BOOKS:

1. *Madigan, M.T., Martinko, J.M. and Parker, J.* 2000. **Brock Biology of Microorganisms**. [Twelfth Edition]. Pearson Benjamin Cummings, San Francisco, USA.
2. *Mackie and McCarthy* 1994. **Medical Microbiology.** [Fortieth Edition]. Churchill Livingstone, New York.

15PMBBTIP201/ 15PMBBCIP201	**INTER DISCIPLINARY COURSE PRACTICAL I: FUNDAMENTALS OF MICROBIOLOGY AND CLINICAL MICROBIOLOGY**	**SEMESTER - II**

Fundamentals of Microbiology and Clinical Microbiology

LIST OF EXPERIMENT

1. Staining techniques - Preparation of Stains.
2. Smear preparation - Heat fixation - Simple staining procedure.
3. Differential staining procedure - Gram's staining.
4. Determination of motility - Hanging drop method.
5. Preparation of Enriched media-Blood agar. Selective media –EMB agar. Differential media- Mac Conkey agar.
6. Pure culture technique: Pour plate method.
7. Spread plate method.
8. Streak plate method – Single line, Quadrant, T-streak, Continuous.
9. Identification of pathogenic organisms – *E. coli* and *S. aureus.*

REFERENCE BOOK:

1. *James G. Cappucino and Sherman Natalie* 2005. **Microbiology – A Laboratory manual**. [Seventh edition]. Pearson education India, New Delhi.

15PVE201	VALUE EDUCATION: HUMAN RIGHTS	SEMESTER- II

Total Hours: 25

OBJECTIVE:

1. To make the students to understand the concepts of human rights.

CONTENTS

UNIT – I **(5 Hours)**

Human Rights: Definition - Historical Evolution - Classification of Rights - Universal Declaration of Human Rights - International Covenants on Economic and Social Rights - Constitutional Provision for Human Rights – Fundamental Rights - Directive Principles of the State Policy – Indian Constitution.

UNIT – II **(5 Hours)**

Civil and Political Rights: Right to Work – Right to Personal Freedom – Right to Freedom of Expression - Right to Property - Right to Education - Right to Equality - Right to Religion - Right to Form Associations and Unions - Right to Movement – Right to Family – Right to Contract – Right to Constitutional Remedies – Right to Vote and Contest in Elections – Right to Hold Public Offices – Right to Petition – Right to Information – Right to Criticise the Government – Right to Democratic Governance.

UNIT – III **(5 Hours)**

Economic Rights: Right to Work – Right to Adequate Wages – Right to Reasonable Hours of Work – Right to Fair Working Conditions – Right to Self Government in Industry – Customer Rights – Social and Cultural Rights – Right to Life - Right to Clean Environment.

UNIT – IV **(5 Hours)**

Women's Rights: Right to Inheritance – Right to Marriage – Divorce and Remarry – Right to Adoption – Right to Education – Right to Employment and Career Advancement – Rights Relating to Dowry – Right for Equality – Right for Safe Working Conditions – Children's Rights – Right to Protection and Care – Right to

Education – Issues Related with Infanticide – Street Children – Child Labour – Bonded Labour – Refugees Rights – Minority Rights – Dalit Rights – Tribal Rights – Nomads Rights.

UNIT – V **(5 Hours)**

Human Rights Violation: International, National, Regional Level Organizations to Protect Human Rights – UNO – National Commission for Human Rights – State Commissions – Non Governmental Organizations and Human Rights – Amnesty Terrorism and Human Rights – Emergency and Human Rights – Judiciary and Human Rights – Media and Human Rights - Police and Human Rights.

REFERENCE BOOK:

1. *Paul Singh.* **Human Rights and Legal System.** Himalaya Publishing House, New Delhi.

15PLS201	CAREER COMPETENCY SKILLS II	SEMESTER – II

Total Hours: 15

OBJECTIVE:

To enhance employability skills and to develop career competency

CONTENTS

UNIT – I **(3 Hours)**

Assertiveness and Self Confidence-Career Opportunities-Industry expectations (Skill set)

UNIT – II **(3 Hours)**

Campus to Corporate-Effective Communication

UNIT – III **(3 Hours)**

Situational Dialogues / Role Play (Telephonic Skills) - Oral Presentations-Prepared -'Just A Minute' Sessions (JAM)

UNIT – IV **(3 Hours)**

Body Language-Dress code-Telephone etiquettes- Email etiquettes-Group Discussion-Creativity-Presentation skills

UNIT – V **(3 Hours)**

Interviewing Techniques- Do's and Don'ts of Interview- Mock Interview.

15PBTM301	CORE X: PLANT AND ANIMAL TISSUE CULTURE TECHNOLOGY	SEMESTER - III

Total Hours: 50

OBJECTIVE:

1. To learn the technique in plant tissue culture and animal cell culture.

CONTENTS

UNIT – I **(10 Hours)**

Architecture of Plants – tissues and organs, Plant response to abiotic stress (Flood, drought and high salinity) and biotic stress (insect), absorption and transportation of water and nutrients by the plants, Transpiration, Seed storage proteins.

UNIT – II **(10 Hours)**

Principles of plant tissue culture, PTC laboratory organization, Plant tissue culture media, sterilization of Explant Callus and suspension culture, Micropropagation, Somaclonal variation, Somatic embryogenesis, Haploid plant production, Isolation and culture of protoplast, Somatic hybridization and Cybridization, Viral free plant production – Meristem culture, Hardening.

UNIT – III **(10 Hours)**

Biosynthesis of Alkaloids, flavanoids, anthocyanins, phenols and their medical applications. Physiological effects and mechanism of action of the auxins, cytokinins, gibberllins and abscissic acid. Biosynthesis and function of ethylene.

UNIT – IV **(12 Hours)**

An Introduction about animal cell culture, Planning and Construction of Lab layout, Equipments - Laminar-flow hood, CO_2 Incubators, Inverted microscope, Cryostorage containers, Aseptic concepts and Cell culture vessel. Preparation of Media- defined media and supplements, Types of cell culture media; Physical and chemical property of Medium, Balanced salts, Antibiotics, growth supplements; Fetal bovine serum; Serum free media.

UNIT – V **(8 Hours)**

Primary culture – Isolation of tissues and disaggregation methods, Subculture and Cell lines. Types of primary culture; separation; Continuous cell lines; Suspension culture; Application of Animal cell culture.

REFERENCE BOOKS:

1. *Bhojwani, S.S. and Razdan, M.K*. 2008. **Plant Tissue Culture – Theory and Practice**. Elsevier Publishers, New Delhi.
2. *Chawla, H.S*. 1998. **Biotechnology in Crop Improvement**. International Book Distribution Co., New Delhi.
3. *Slater, A., Scott, N. and Fowler. M.* 2008. **Plant Biotechnology – The Genetic Manipulation of Plants.** [Second Edition]. Oxford Publications, Oxford, UK.
4. *Hopkins, W.G., and Hiiner, N.P.A*. 2004. **Introduction to Plant Physiology**. [Third Edition]. John Wiley and Sons, New Jersey, USA.
5. *Jain, V.K.* 2013. **Fundamentals of Plant Physiology**. [Fifth Edition]. S. Chand and Company, NewYork.

6 Trivedi, P.C. 2004. **Advances in Plant Physiology**. [Third Edition]. I.K. International Publications Pvt Ltd, New Delhi.

7. Freshney, R.I., 2005. **Culture of Animal Aells: A Manual of Basic Technique.** [Fifth Edition]. John Wiley and Sons , New Jersey.

15PBTM302	CORE XI: ADVANCES IN rDNA TECHNOLOGY AND BIOETHICS	SEMESTER - III

Total Hours: 50

OBJECTIVE:

1. To know about the advances in rDNA technology and its importance in various fields.

CONTENTS

UNIT – I **(10 Hours)**

History and scope of genetic engineering. Enzymes in Genetic engineering – DNA modifying enzymes – i) Restriction enzymes, ii) DNA polymerase –Klenow, DNA polymerase I, T4 DNA Polymerase, iii) Reverse transcriptase, iv) Terminal transferase, v) T4 polynucleotide kinases, vi) Alkaline phosphatase, vii) DNA ligase, viii) Nucleases –Bal 31, S1 nucleases, DNase I, Mungbean nucleases, Ribonucleases, EXO III, RNA polymerase, Thermostable enzymes.

UNIT – II **(10 Hours)**

Bacterial vectors- pBR322 and pUC vectors. Phage vectors – Lambda, M13, Cosmid and Phagemid, Artificial chromosomes – YAC, BAC, PAC and HAC, Expression vectors and Shuttle vectors. Host cell types and transformation.

UNIT – III **(10 Hours)**

Cloning strategies – Gene library construction – Genomic and cDNA libraries. DNA cloning –Homopolymer tailing and use of adapters and linkers. Screening and analysis of recombinants – radiolabeled and non-radiolabeled probes. Blotting techniques – Southern/Northern/Western. Immunological screening of expressed genes.

UNIT – IV **(10 Hours)**

DNA sequencing – Chemical, enzymatic and automated DNA sequencing. Microarrays – Principles and applications. PCR – Principle, types and applications, Site directed mutagenesis and Protein engineering. Gene therapy, Gene knockout technologies.

UNIT – V **(10 Hours)**

Biotechnology - Society, Risks, Ethics. ELSI of Biotechnology, Ethical issues in rDNA technology, transgenic plants and animals, Recombinant therapeutic products for human health care, Human embryonic stem cell research-cloning.

REFERENCE BOOKS:

1. *Primrose S.B and Twyman, R.M.* 2006. **Principles of Gene Manipulation and Genomics**. [Seventh Edition]. Blackwell Publishing Co., USA.
2. *Ernst-L.Winnacker.* 2003. **From Genes to Clones**. Panima Publishing Co., Bangalore.
3. *Reece, R.J.* 2004. **Analysis of Genes and Genomes**. John Wiley and Sons Ltd., USA.
4. *Brown, T.A* .2007. **Genomes**. [Third Edition]. Garland Science, USA.
5. *Joseph Sambrook and David W. Russell*, 2001. **Molecular cloning – A laboratory manual Volume 1 to 3**. [Third Edition]. Cold Spring Harbor Laboratory Press, New York.
6. *James D. Watson, Richard M. Myers, Amy A. Caudy, Jan A. Witkowski*. 2006. **Recombinant DNA.** [Third Edition]. W.H Freeman & Company, New York.
7. *Micklos, D.A., Freyer, G.A. and Crotty, D.A*. 2003. **DNA science**. [Second Edition]. Cold Spring Harbor Laboratory Press, New York.
8. *Satheesh, M.K.* 2011. **Bioethics and Biosafety**. I.K. International, New Delhi.

15PBTM303	CORE XII: FOOD AND PHARMACEUTICAL BIOTECHNOLOGY	SEMESTER - III

Total Hours: 50

OBJECTIVES:

1. To understand the basics about the food and food products.
2. To understand the basics about the pharmaceutical biotechnology

CONTENTS

UNIT – I **(10 Hours)**

Constituents and dietary sources of food – Carbohydrates, Lipids, Proteins, Water, Vitamins and Minerals, Fermented Cereals food: Soy Sauce, Miso, Idli. Fermented fish products. Fermentation of vegetables: Sauerkraut Pickles.

UNIT – II **(10 Hours)**

Production of bread, distilled beverages- wine and beer. Production of food flavourant and colorants, Production of baker's yeast, Food spoilage – Factors responsible for spoilage.

UNIT – III **(10 Hours)**

Principles and methods of food preservation: Asepsis removal, Anaerobic conditions, Preservation by use of high temperature, low temperature, drying, food additives, radiation, Pasteurization, Blanching, Canning.

UNIT – IV **(10 Hours)**

History and scope of Pharmaceutical biotechnology, Production of antibiotics from the microbes- penicillin, streptomycin, Manufacturing of drugs and principles. Packing techniques of Drugs and tablets.

UNIT – V **(10 Hours)**

Quality assurance and control – concept of good manufacturing practices, role of FDA, and their release into the market, Hormones. Drug metabolism – biotransformation of drugs, enzymes responsible for biotransformation, microsomal and non-microsomal mechanisms, Pharmacology - pharmacodynamics pharmacokinetics.

REFERENCE BOOKS:

1. *Daan, J., Crommelin, A., Robert D. Sindelar, Bernd Meibohm,* 2008. **Pharmaceutical Biotechnology – Fundamentals and Applications.** Informa Healthcare USA, Inc.
2. *Toledo, R.T.* 1980. **Fundamentals of Food Processing**. [Third Edition]. AVI Publishing Company, USA.
3. *Coultate, T.P.* 1992. **Food – The Chemistry of Its Components**. [Second Edition]. Royal Society, London.
4. *Jay, J.M.* 1987. **Modern Food Microbiology**. [Third Edition]. CBS Publications, New Delhi.
5. *Kayser. O. and Müller, R. H.* 2004. **Pharmaceutical Biotechnology: Drug Discovery and Clinical Applications.** Wiley Publications.

15PBTM304	CORE XIII: BIOSTATISTICS AND RESEARCH METHODOLOGY	SEMESTER - III

Total Hours: 50

OBJECTIVES:

1. To learn the strategies of research field and also to provide skills sufficient to allow to understand the role of statistics in research.
2. To ignite the young minds with research thought.

CONTENTS

UNIT – I **(10 Hours)**

Bio Statistics - Meaning, Importance and usefulness and Variable – Scale Measurements, Collection of data – Questionnaire, Classification – Tabulation – Diagrammatic and graphical representation of biological data.

UNIT – II **(10 Hours)**

Measures of central tendency: Mean, Median and Mode only. Measures of Variation: Standard Deviation only – Correlation and Regression, Probability: Definition – Simple problems based on addition and multiplication theorem – Normal Distribution – Properties and its importance.

UNIT – III **(10 Hours)**

Population – Sampling Methods – Statistical Inference – Point Estimation and Interval Estimation (Concept only) – Hypothesis – Simple Hypothesis – Standard Error – t test – Chi-square test, ANOVA (one –way and Two-way only) - Introduction to Statistical software.

UNIT – IV **(10 Hours)**

Research – Planning and Classification, Components of research report, Essential steps in research. Literature collection, Literature citation, Different systems for citing reference- Name, year systems- citation in text and reference. Experimental design. Preparation of manuscript – report writing – format of journals – proof reading. Sources of information

UNIT – V **(10 Hours)**

Research report writing - Report, Table, Figures, Format of Thesis. Journals – Standard of Research journals – impact factors – citation index, search scientific information – google, pubmed – national informatics center network services.

Scientific information- Introduction, Writing a proposals, scientific papers and figures.

TEXT BOOKS:

1. *Gupta, S.P*. 2008. **Statistical Methods.** [Thirty Seventh Edition]. Sultan Chand and Sons. New Delhi. (**UNIT II & III**)
2. *Gurumani, N*. 2005. **An Introduction to BIOSTATISTICS**. [Second Edition]. MJP Publishers, Chennai. (**UNIT I**)
3. *Gurumani, N*. 2006. **Research Methodology**. MJP Publishers. (**UNIT IV & V**)

REFERENCE BOOKS:

1. *Antonisamy, B., Solomon Christopher and Prasanna Samuel.* 2010. **Biostatistics: Principles and Practice**. Tata McGraw Hill Education Private Limited. New Delhi.
2. *Padmini E.* 2007. **Biochemical Calculations & Biostatistics**. [First Edition]. Books and Allied (P) Ltd., Kolkata.
3. *Kothari, C.R.* 1990. **Research Methodology – Methods and Techniques**. New Age Publications. New Delhi
4. *Davis, G.B. and Parker C.A.* 1997. **Writing the Doctoral Dissertation**. [Second Edition]. Barrons Educational Series.
5. *Duncary, P*. 2003. **Authoring a PhD thesis**: **how to plan, draft, write and finish a doctoral dissertation.** Macmillan.
6. *Michael P. Maroer.* 2001.**Research method for Science.** Cambrige University Press.

15PBTMP301	CORE PRACTICAL – III	SEMESTER - III

LIST OF EXPREMENT

rDNA technology, Plant and Animal tissue culture

1. Isolation of Genomic DNA from Bacteria
2. Isolation of plasmid DNA
3. Restriction Digestion
4. Ligation
5. Southern Blotting
6. Polymerase Chain Reaction
7. Bacterial Transformation
    a. Competent Cell preparation
    b. Transformation of plasmid in to a competent cell
8. Media preparation for Animal Cell Culture
9. Primary and secondary culture of animal cells
10. Chick embryo fibroblast
11. Determination of viability of cells using Trypan blue stain
12. Preparation of media for Plant Tissue Culture
13. Selection and sterilization of explants for callus induction
14. Micropropagation
15. Isolation of plant DNA by CTAB method
16. Protoplast isolation
17. Embryo culture
18. Root and Shoot induction
19. Suspension culture

REFERENCE BOOKS:

1. *Bhojwani, S.S. and Razdan, M.K*. 2008. **Plant Tissue Culture – Theory and Practice**. Elsevier Publishers, New Delhi.
2. *Freshney, R.I.* 2005. **Culture of Animal Cells: A manual of basic technique.** [Fifth Edition]. John Wiley and Sons, New Jersey.
3. *Joseph Sambrook and David W. Russell*, 2001. **Molecular cloning – A laboratory manual Volume 1 to 3**. [Third Edition]. Cold Spring Harbor Laboratory Press, New York.
4. Aneja, K.R. 2003. **Experiments in Microbiology, Plant pathology and Biotechnology.** [Fourth Edition]. New age international.

15PBTEL301	ELECTIVE I : COMPUTATIONAL BIOLOGY	SEMESTER - III

Total Hours: 50

OBJECTIVE:

1. This course enables the students to be aware of the basic theoretical and practical aspects of bioinformatics concepts like,
    a) Biological Database searching
    b) Phylogenetic analysis
    c) Protein modeling

CONTENTS

UNIT – I **(13 Hours)**

Bioinformatics: Objectives, Applications. Biological Database: Classification, Database submission systems. Biological data formats, Format Conversion – Readseq. **Sequence Assembly:** Overview, Global assembly, File format and Phrap assembly. PCR Primer Design: designing considerations, Primer3 analysis and *Insilico* PCR amplification.

UNIT – II **(9 Hours)**

Databanks: Sequence data banks: Nucleic acid and Protein sequence databases (EMBL, GENBANK, DDBJ, PIR, and SWISS PROT), Structural database – PDB, CSD, and CATH.

UNIT – III **(12 Hours)**

Sequence Analysis: Overview, Sequence alignment – Local/ Global alignment, Pair wise and Multiple Sequence Alignment: Principle, methods and applications. Tools for sequence analysis – BLAST, Clustal W

UNIT – IV **(8 Hours)**

Structural Analysis: Protein structural classification - Protein secondary (Chou-Fasman, ExPasy server) and tertiary structure prediction (Homology Modeling), General overview of Gene prediction.

UNIT – V **(8 Hours)**

Phylogenetic Analysis: Overview, Phylogenetic tree: rooted and unrooted tree. Tree constructing methods: UPGMA, and Maximum parsimony methods, Tools for prediction (PHYLIP).

TEXT BOOKS:

1. *David W Mount.* 2004. **Bioinformatics: Sequence and Genome Analysis.** [Second Edition]. CSHL.
2. *Attwood, T. K.* and *Parry Smith. D. J.* **Introduction to Bioinformatics. [**First Edition]. Pearson Education.

REFERENCE BOOKS:

1. *Kothekar. V.* and *Nandi. T.* 2007. **An Introduction to Bioinformatics**. [Second Edition]. Duckworth Press- Bioscience Publishers, New Delhi.
2. *Andreas D Baxevanis.* and *Francis. B. F.* 2002. **Bioinformatics- A Practical Guide to Analysis of Genes and Proteins.** John Wiley Publications.

15PBTEL302	ELECTIVE II: DOWNSTREAM PROCESSING	SEMESTER - III

Total Hours: 50

OBJECTIVE:

1. To impart knowledge about industrial aspects of product recovery.

CONTENTS

UNIT – I **(8 Hours)**

Introduction to downstream processing, Primary and Secondary metabolite, Enzymes/Proteins – Intracellular enzyme, extracellular enzyme and cell wall bound enzyme.

UNIT – II **(9 Hours)**

Removal of microbial cells, removal of solid matter – separation technique – physical separation, foam separation, centrifugation, filtration, seed filter, tangential flow filter, Chemical method – precipitation.

UNIT – III **(13 Hours)**

Protein extraction and solubilization – Homogenization, Sonication, French Pressure cell, Glass bead vortexing, Biological method – Enzymatic Treatment. Chemical lysis method – Detergent, Organic solvent, Osmotic shock, Freeze - Thaw lysis. Cell disruption - physical method- Beads, Dyno mills, High pressure homogenizer, Colloid mill, Chemical method- Solvent, detergent and organic shock and enzyme treatment.

UNIT – IV **(10 Hours)**

Concentrating protein solution – Trichloroacetic acid precipitation, Immunoprecipitation, Ammonium sulfate precipitation, Poly ethylene glycol precipitation PEG, Ultra filtration, dialysis, Ion exchange chromatography and lyophilization.

UNIT – V **(10 Hours)**

Purification and crystallization of proteins – Ion exchange chromatography, Gel filtration chromatography, affinity chromatography, hanging drop crystallization.

REFERENCE BOOKS:

1. *Daniel M. Bollag, Michael D. Rozycki, Stuart J. Edelstein*, 1996. **Proteins Method.** [Second Edition]. A John Wiley and Sons, Inc., Publication.
2. *Stanbury. P.R* and *Whitaker.* 2002. **Principles of Fermentation Technology**. Elsevier Science Ltd.
3. *Pauline M Doran.*1995. **Bioprocess Engineering Principles**. Academic Press.
4. *Shuler, M.L* and *Kargi, F*. 2004. **Bioprocess Engineering: Basic Concepts.** [Second Edition]. Prentice Hall Pvt. Ltd., New Delhi.
5. *Aiba, S., Humphrey. A.E.* and *Millis, N.F.* 1973. **Biochemical Engineering**. [Second Edition]. Academic Press. New York.
6. *Crueger, W.* and *Crueger, A*. 2002. **A Text Book of Industrial Microbiology.** [Second Edition]. Science Tech Publishers, USA.

15PBTEL303	ELECTIVE III: DNA CLONING	SEMESTER - III

Total Hours: 50

OBJECTIVE:

1. To obtain knowledge in cloning techniques in DNA.

CONTENTS

UNIT – I **(10 Hours)**

DNA Cloning, choosing a vector, Techniques for transformation of *E.coli* – competence induction, method of transformation, electroshock method, Strain for transformation.

UNIT – II **(10 Hours)**

cDNA cloning – cloning strategy, standard library construction, PCR technique in cDNA cloning, Construction of genomic DNA library by Lambda replacement vector –Donor and vector DNA, recovery of recombinant DNA molecules. Library size.

UNIT – III **(10 Hours)**

Screening procedures –making nucleic acid probes, primer extension from random oligonucleotides, RNA probes, end labeling, Non- radioactive probes. Library screening-chromosome walking, differential screening, subtracted probes and subtraction libraries

UNIT – IV **(10 Hours)**

Expression strategies - Gene Expression in *E. coli, Saccharomyces cerevisiae, Schizosaccharomyces,* Expression in insect cells, higher eukaryotic system – Tet On/Off systems, Phage display.

UNIT – V **(10 Hours)**

Purification of proteins from *E.coli* – factors that affect physical properties of over-produced proteins, purification of soluble recombinant proteins, use of affinity technique, processing of fusion proteins.

REFERENCE BOOKS:

1. *Glover, D. M.* and *Hames, B. D*. 2006. **DNA Cloning, Volume 1 to 4. A Practical Approach**. Oxford University Press.

2. *Joseph Sambrook* and *David W. Russell*, 2001. **Molecular Cloning – A laboratory Manual, Volume 1 to 3.** [Third Edition]. Cold Spring Harbor Laboratory Press, New York.
3. *Ernst L.Winnacker*. 2003. **From Genes to Clones**. Panima Publishing Co. Bangalore
4. *Brown T.A* .2007. **Genomes**. [Third Edition]. Garland Science USA.
5. *Reece, R.J.* 2004. **Analysis of Genes and genomes.** John Wiley and Sons Ltd., USA.
6. *Micklos, D.A., Freyer, G.A. and Crotty, D.A*. 2005. **DNA Science**. IK International Private limited, New York.

15PBCMBI301/ 15PBCBTI301	INTERDISCIPLINARY COURSE II: PHARMACEUTICAL BIOCHEMISTRY	SEMESTER - III

Total Hours: 36

OBJECTIVE:

To enable the students to learn about

1. Pharmacodynamics and pharmacokinetics of drugs.
2. Plant therapeutics.

CONTENTS

UNIT - I **(7 Hours)**

Drugs: History of Drugs, Definition-Nomenclature. Classification of drugs based on their source – Plant, animal, mineral and synthetic, based on action. Routes of drug administration, Drug absorption- mechanism. Factors influencing drug absorption.

UNIT - II **(7 Hours)**

Distribution and elimination of drugs. Factors influencing drug distribution and elimination. Mechanism of drug action- Physical, Chemical, Enzymes, Receptors.
Drug-Receptor interactions: Receptor – Definition Agonist, partial aganoist and antagonist. Forces involved in drug-receptor interaction. Drug action not mediated through receptor. Dose response relationship (LD_{50} and ED_{50}).

UNIT - III **(7 Hours)**

Adverse drug reactions- Definition, Classification and drug induced side effects, biological effects of drug abuse and drug dependence, drug tolerance and intolerance.
Drug discovery- Animal toxicity studies and clinical evaluation Phase I-IV (Elementary details)

UNIT - IV **(7 Hours)**

Phytomedicine**:** History, Definition, Introduction and Scope of Phytomedicine. Indian Medicinal systems– Ayurveda, Siddha and Unnani. Medicinal properties and active principles of plant parts (leaves, flowers, roots, seeds, rhizome, bark etc). Role of medicinal and aromatic plants in national economy.

UNIT - V **(8 Hours)**

Secondary metabolites of plants - Alkaloids, flavonoids and terpenoids, phenols – occurrence, distribution and functions. (Synthesis not required). Extraction of Phytopharmaceuticals or crude drugs – (Aqueous, Methonol and Chloroform

extracts) maceration, percolation and soxhlet extraction - Analysis of phytochemicals (carbohydrates, aminoacids, proteins, phenols, flavonoids, alkaloids tannins, glycosides, saponins and terpenoids).

TEXT BOOKS:

1. *Tripathi, K. D*. 1999. **Essentials of Medical Pharmacology.** [Fourth Edition]. Jaypee Brothers Medical Publishers, New Delhi **(UNIT - I, II & III).**
2. *Kokate, C. K., Purohit, A. P.* and *Gokhale, S.B*. 2007. **Pharmocognosy.** [Thirty Seventh Edition]. Nirali Prakasham, Pune. **(UNIT – IV & V).**

REFERENCE BOOKS:

1. Satoskar, R. S., Nirmala N. Rege and *Bhandarkar S.D,* 2011. **Pharmacology and Pharmacotherapeutics** [Twenty-Second edition]. Popoular Prakashan Pvt Ltd, Mumbai**.**
2. Roseline, A. 2011**. Pharmacognosy.** M.J.P Publishers, Chennai**.**

15PBCMBIP301/ 15PBCBTIP301	**INTERDISCIPLINARY COURSE PRACTICAL II : PHARMACEUTICAL BIOCHEMISTRY**	**SEMESTER - III**

LIST OF EXPERIMENT

1. Extraction of phytoconstituents of neem leaves using water and methanol as solvents- Maceration and Soxhlet extraction.
2. Preliminary phytochemical screening for the presence of following constituents
   - (i) Carbohydrates
   - (ii) Lipids
   - (iii) Proteins and Amino acids
   - (iv) Phenols
   - (v) Flavonoids
   - (vi) Anthraquinones
   - (vii) Alkaloids
   - (viii) Terpenoids
3. Quantitative estimation of proteins (Lowry's method).
4. Quantitative estimation of carbohydrates (Anthrone method).
5. Quantitative estimation of phenols (Singleton and Rossi's method).
6. Isolation and partial purification of phytoconstituents (Phenol and Flavonoids) using

   Chromatographic techniques (TLC, silica gel and aluminium oxide).

REFERENCE BOOK:

1. *Kokate, C.K., Purohit, A.P.* and *Gokhale, S.B.* 2008. **Phytochemical Methods.** Nirali Prakasham, Pune.

15PMBBTI301/ 15PMBBCI301	INTER DISCIPLINARY COURSE II : INDUSTRIAL MICROBIOLOGY	SEMESTER- III

Total Hours : 40

OBJECTIVES:

1. To learn the basics of bioprocess techniques.
2. To know about fermentor design and production of various fermented products.

CONTENTS

UNIT – I **(8 Hours)**

Introduction to bioprocess technology - Historical development of industrial microbiology – screening techniques – primary and secondary – preservation of industrial cultures – objective – Lyophilization and Cryogenic storage. Strain improvement – rDNA technology - strain development for various fermentation process.

UNIT - II **(8 Hours)**

Media for industrial fermentation – formulation – sterilization – fermentation types – solid state and submerged fermentation – Downstream processing - Foam separation – Precipitation - Filteration – Cell disruption – physico – mechanical and chemical. Solvent recovery and drying.

UNIT – III **(8 Hours)**

Fermentor – component parts of fermentor – Body construction - stirring and mixing – scale up window – control of pH, temperature, foam and pressure – types of bioreactors – Air lift and cylindro conical bioreactors.

UNIT - IV **(8 Hours)**

Microbial production of fermented products – Wine. Organic acid – Citric acid and Lactic acids. Vitamin – Vitamin B_{12}. Enzyme – α-amylase

UNIT – V **(8 Hours)**

Microbial production of antibiotic – Penicillin - Streptomycin; Vaccines – BCG; Toxoid – Tetanus Toxoid – Preparation of antisera.

TEXT BOOKS:

1. *Stanbury, P.F., Whitaker, A., and Hall, S.J., 2005.* **Principles of Fermentation technology.** Reed Elsevier India Ltd., New Delhi.
2. *Cruegar, W and Cruegar, A.* 1989. **Biotechnology**: **A Textbook of Industrial Microbiology**. Panima Publishing Corporation, New Delhi.

REFERENCE BOOKS:

1. *Michael J Waites, John S Roackey, Neil L. Morgan and Garry Highton.* 2006. **Industrial Microbiology – An Introduction**. Blackwell Science Ltd., USA.
1. *Hugo, W.B. and Russell, A.D.* 1998. **Pharmaceutical Microbiology.** [Sixth Edition]. Blackwell Scientific Company Ltd., USA.

15PMBBTIP301/ 15PMBBCIP301	INTER DISCIPLINARY COURSE PRACTICAL II : INDUSTRIAL MICROBIOLOGY	SEMESTER - III

Industrial Microbiology

LIST OF EXPERIMENT

1. Screening of antibiotic producing organisms from soil.
2. Screening of amylase enzyme producing organisms from soil.
3. Antibiotic sensitivity disc preparation.
4. MIC determination by filter paper disc assay.
5. Antibiotic susceptibility method – Kirby Bauer method.
6. Evaluation of disinfectant – Phenol Coefficient method. (demonstration)
7. Wine production (demonstration)

REFERENCE BOOK:

1. *Aneja, K.R.,* 2002**. Experiments in Microbiology, plant pathology, tissue culture and mushroom culture production technology**. [Third edition]. New Age International Publishers (P) Ltd. New Delhi.

15PBTM401	CORE XIV: CORPORATE BIOTECHNOLOGY	SEMESTER - IV

OBJECTIVE:

1. To equip the student to meet the standards of the corporate world.

CONTENTS

UNIT – I

Corporate registration and Intellectual property rights an Introduction, Trade mark and Registration - registration of company, Patents - Parenting Molecular biotechnology. Intellectual property rights – legal aspects. Preparation of project for loans through government and banking agencies.

UNIT – II

Maintenance and care of laboratory animals – mice, rabbit, guinea pig, chicken. Livestock production, Animal health, increasing productivity Biotechnology in Aquaculture - Transgenic fishes. Benefits of transgenic animals.

UNIT – III

Transgenic plants: Transgenic crops- Herbicide tolerance plants, Temperature tolerant plant, Saline tolerant plant, and Bt cotton and Bt Brinjal, Quality improvement in crops – Golden rice, FLAVR SAVR™ tomato, Regulation of transgenic crops.

UNIT – IV

Vertical farming – History and development, feeding the world in 21st century, design and construction of vertical farms- urban design, food and energy harvesting, programmatic synergy. Vertical farm as bio-resource unit, Benefits of vertical farming.

UNIT – V

Silvi culture – General principles, silvi culture systems, management and establishment of silvi culture system, choice of species, traditional and recent advances in silvi culture research and practices.

REFERENCE BOOKS:

1. *Chawla, H.S*. 2002. **Introduction to Plant Biotechnology.** [Second Edition]. Science Publishers.

2. *Freshney, R.I.* 2005. **Culture of Animal Cells: A manual of basic technique.** [Fifth Edition]. John Wiley and Sons, New Jersey.
3. *Glick R. Bernard* and *Pasternak J. Jack.* 2007. **Molecular Biotechnology**. [Third Edition]. ASM Press, Washington, D.C.
4. *Purohit, S.S.* 2009. **Biotechnology: Fundamentals and Applications.** [Fourth Edition]. Students Edition.

GUIDELINES

MARK DISTRIBUTION

1. SUBMISSION OF RECORD NOTE BOOKS AND PROJECT DISSERTATION:

Candidates appearing for Practical Examinations and Project Viva-Voce shall submit Bonafide Record Note Books/ Dissertation prescribed for Practical/ Project Viva-Voce Examinations, otherwise the candidates will not be permitted to appear for the Practical/ Project Viva-Voce Examinations.

2. PASSING MINIMUM AND INTERNAL MARK DISTRIBUTION (Theory, Practical and Project)

(i) A. THEORY

The candidate shall be declared to have passed the Examination, if the candidate secure not less than 50 marks put together out of 100 in the Comprehensive Examination in each Theory paper with a passing minimum of 38 marks in External out of 75.

***Internal Marks Distribution** [CA- Total Marks: 25]*

Attendance	: 5 Marks
Assignment	: 5 Marks
Seminar	: 5 Marks
Internal Examinations	: 10 Marks
Total	**: 25 Marks**

Question paper pattern for theory examinations
(Maximums marks: 75)

PART A
Answer all questions (5 x 5 = 25)
(Internal Choice questions)

PART B
Answer all questions (5 x 10= 50)
(Internal Choice questions)

B. (i) THEORY (If Internal Evaluation is for 100 Marks)

The candidate shall be declared to have passed the Examination, if the candidate secures not less than 50 marks out of 100.

***Internal Marks Distribution* [CA- Total Marks: 100]**

Attendance	: 10 Marks
Assignment	: 20 Marks (2 Assignments Compulsory)
Seminar	: 10 Marks
Internal Examinations	: 60 Marks
Total	**: 100 Marks**

B. (ii) THEORY (If External Evaluation is for 100 Marks)

The candidate shall be declared to have passed the Examination, if the candidate secures not less than 50 marks out of 100 in the Comprehensive Examination (External Evaluation only).

Question paper pattern for theory examinations *and Mark Distribution* (For 100 marks)

PART – A

Answer all questions (5 x 5 = 25 Marks)

One question from each UNIT with Internal Choice

PART – B

Answer ALL questions (5x 15 = 75 Marks)

One question from each UNIT with Internal Choice

(ii) PRACTICAL

The candidate shall be declared to have passed the Examination, if the candidate secure not less than 50 marks put together out of 100 in the Comprehensive Examination in each Practical paper with a passing minimum of 30 marks in External out of 60.

Marks Distribution

Continuous Assessment (CA) - 40 marks
Comprehensive Examination (CE) - 60 marks

Internal Marks Distribution *[CA- Total Marks: 40]*

Experiment	: 10 Marks
Attendance	: 5 Marks
Record	: 5 Marks
Internal Examinations	: 20 Marks
Total	**: 40 Marks**

Comprehensive Exam Marks Distribution *[CE- Total Marks: 60]*

Major experiment	: 25 Marks
Minor experiment	: 15 Marks
Spotters	: 5X2=10 Marks
Viva voce	: 10 Marks
Total	**: 60 Marks**

Submission of Record Note Books

Candidates appearing for Practical Examinations shall submit Bonafide Record Note Books for Practical Examinations; otherwise the candidates will not be permitted to appear for the Practical Examinations.

QUESTION PAPER PATTERN FOR PRACTICAL EXAMINATIONS

Max marks	: 60
Time	: 6Hrs/9Hrs (6+3)
Major experiment	: 25 Marks
Minor experiment	: 15 Marks
Spotters	: 5X2=10 Marks
Viva voce	: 10 Marks

Key for evaluation of Practical Examination

1. **Major (25 Marks)**

Procedure	: 15 Marks
Performance	: 05 Marks
Result	: 05Marks

2. **Minor (15 Marks)**

Procedure	: 10 Marks
Performance	: 03 Marks
Result	: 02 Marks

3. **Spotters** : 5x2=10 Marks

4. **Viva – Voce** **:** 10 Marks

iii) CERTIFICATE COURSE

Classification of Marks

Examinations	: 50 Marks (5X10=50)
Practical/Performance	: 15 Marks
Assignment	: 30 Marks (3 Assignment)
Attendance	: 05 Marks
Total	**: 100 Marks**

III) PROJECT WORK /DISSERTATION

The project work shall be carried out by each student in the IV semester and has to complete the work at the end Semester.

- Upon completion of the project work/dissertation the candidate will be required to appear for a viva-voce conducted by an external examiner.
- The Student has to attend three reviews before completing his/her Project.
- All three reviews will be reviewed by Subject expert.
- A candidate failing to secure the prescribed passing minimum in the dissertation shall be required to re-submit the dissertation with the necessary modifications.

Mark Distribution Pattern

Comprehensive Examination (CE)	**:150 Marks**
Continuous Assessment (CA)	**: 50 Marks**

The candidate shall be declared to have passed the Examination, if the candidate secures not less than 100 marks put together out of 200. In the Comprehensive Examination in Project with a passing minimum of 75 marks in External out of 150.

Internal Mark Distribution **[CA - Total Marks: 50 Marks]**

1. Research work done	:	20 Marks
2. Attendance	:	5 Marks
3. Observation Note	:	10 Marks
4. Review	:	15 Marks
Total	**:**	**50 Marks**

External Mark Distribution [CE - Total Marks: 150 Marks]

1. Project report : 100 Marks
2. Presentation : 25 Marks
3. Viva Voce : 25 Marks

Total : 150 Marks

IV) CAREER COMPETENCY SKILLS- METHODOLOGY OF ASSESSMENT

On Line Objective Examination (Multiple Choice questions)

- 100 questions-100 minutes
- Twenty questions from each UNIT.
- On line examination will be conducted at the end of the III Semester.

Viva Voce

- A Student has to come in proper dress code and he/she should bring 2 copies of Resume for the Viva Voce.
- A student may be asked to
  - Give Self Introduction
  - Submit the resume to the examiner(s) and answer the questions based on it.
  - Speak on any given topic for at least two minutes.
  - Give a presentation for 10 minutes on a topic of their choice.
  - Sit with other students in a Group for a Discussion.

	CERTIFICATE COURSE: MUSHROOM CULTIVATION	SEMESTER - III

Total Hours: 50

OBJECTIVE:

1. To learn the techniques of Mushroom cultivation.

CONTENTS

UNIT – I **(10 Hours)**

Mushroom Biology and Mushroom science –Types, Mushroom fungi, Fungus ecology, Life cycle of fungi, Temperature ranges of cultivated mushrooms. Landmarks and world production – Historical records, Industrial approach, Indian scenario, Nutritional, Medicinal value of mushroom, Mushroom farms – Farm layout and farm hygiene.

UNIT – II **(10 Hours)**

Mushroom biotechnology – solid state fermentation, genetically transformed mushrooms, characterization and evaluation of germplasm, molecular cloning and heterologous expression, isolation of fungal protoplast and protoplast fusion. Mushroom Spawn – sterilization, culture room, Pure culture techniques – tissue culture, multispore isolation and single spore isolation, Types of spawn – natural, liquid, grain spawn, spawn quality.

UNIT – III **(10 Hours)**

Casing – casing substrate, properties, role and preparation of casing soil. Growing Button Mushroom, compost and composting, Pasteurization and conditioning, environmental condition in cropping room, Growing oyster mushrooms on pasteurized or sterilized substrates – Preparation of substrate, heat treatments, spawning pasteurized substrate, spawning sterilized bag, spawn run, fruiting/cropping, harvesting.

UNIT – IV **(10 Hours)**

Milky mushroom – genus and special features, cultivation technique, Paddy straw mushroom and its method of cultivation. Cultivation on plastic bags – substrate preparation, filling and heat treatment, spawning, spawn run and mycelia development, fruiting, harvesting, pest and diseases.

UNIT – V **(10 Hours)**

Pest management in mushroom cultivation- biological control, chemical control, mushroom nematodes Weed moulds and fungal diseases, bacterial and viral diseases of mushroom, Harvest and post harvest storage and 'Wood ear mushrooms' on sterilized substrate, preparation, heat treatment, spawning and spawn run, fruiting, Post harvest handling – fresh market and drying.

TEXT BOOK:

1. *Krishnmoorty, S., Marimuthu, T. and Nakkeran, S.* 2005. **Mushroom Biotechnology**. TNAU Press, Coimbatore, India.

REFERENCE BOOK:

1. *Peter Oei,* 2005. **Small Scale Mushroom Cultivation**. Digigrafi, Wageningen. The Netherlands.

INTER DISCIPLINARY COURSE (IDC)

S.NO	SUBJECT CODE	SUBJECT	SEMESTER	OFFERED TO THE STUDENTS OF
1	15PBTMBI201/ 15PBTBCI201	IDC I: Plant Tissue culture technology	II	Microbiology/Biochemistry
2	15PBTMBIP20/ 15PBTBCIP201	IDC Practical I: Plant Tissue culture technology	II	Microbiology/Biochemistry
3	15PBTMBI301/ 15PBTBCI301	IDC II: Animal Tissue culture technology	III	Microbiology/Biochemistry
4	15PBTMBIP30/ 15PBTBCIP301	IDC Practical II: Animal Tissue culture technology	III	Microbiology/Biochemistry