MASTER OF SCIENCE (BIOTECHNOLOGY)

VISION

To nurture the young minds with a potential to innovate, invent and disseminate knowledge for the benefit of the society and environment.

MISSION

- To motivate the learners to take up challenging task in biotechnology and to prepare for a career of self-employment through environmental friendly biotechnology enterprises.
- To innovate and explore novel solution for the existing problems in the fields of environment, agriculture, animal biotechnology and health sector.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

PEO 1: To succeed in obtaining employment appropriate to their interest, education and will become productive and valued professional in Biotechnology domain.

PEO 2: To develop professionally through lifelong learning, higher education in their area of interest.

PEO 3: To cater to the needs of the industry/society so as to contribute for the development of the country.

PROGRAMME OUTCOMES (PO)

After completion of the programme, the graduates will be able to

PO 1: Use the basic knowledge towards applied Plant/ Animal/ Environmental Biotechnology.

PO 2: Design processes / products for Biotechnology Industries.

PO 3: Design, analyze and interpret data for investigating research problems in biotechnology and other fields.

PO 4: Justify societal, health, safety and legal issues and understand his responsibilities in biotechnological practices.

PO 5: Take up independent / team research in a multidisciplinary environment and the outcome of the course will make the student ready for lifelong learning of Biotechnology.

PROGRAMME SPECIFIC OUTCOMES (PSO)

After completion of the programme, the graduates will be able to

PSO 1: Apply the knowledge of Biotechnology in the domain of environmental, immunology, agriculture, healthcare and, molecular mechanics in Bioindustry.

PSO 2: Solve the complex problem in the field with a understanding of societal, legal and cultural impact of the solution.

PSO 3: Apply the contextual knowledge of Biotechnology to function effectively as an individual or leader in multidisciplinary domain of Biotechnology.

PSO 4: Predict, formulate, demonstrate, analyze and interpret data for integrating research problem in life science domain.

PSO 5: Synthesis, compare, evaluate, classify, integrate and effectively apply the basic laws, principles, phenomena, process and mechanism involved in the domain of 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 PROGRAMME:

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

MAXIMUM DURATION FOR THE COMPLETION OF THE PG PROGRAMME

The maximum duration for completion of the PG Programme shall not exceed 12 semesters.

SCHEME OF EXAMINATION

Subject Code	Subject	Hours of Instruction	Exam Duration (Hours)	Maximum Marks			Credit Points
				CA	CE	Total	
FIRST SEMESTER							
Part-A							
18PBTM101	Core I: Cell Biology	5	3	25	75	100	5
18PBTM102	Core II: Molecular biology	5	3	25	75	100	5
18PBTM103	Core III: Microbiology & Genetics	5	3	25	75	100	5
18PBTM104	Core IV: Biochemistry	5	3	25	75	100	5
18PBTM105	Core V:Developmental Biology	5	3	25	75	100	5
18PBTMP101	Core Practical I: Lab in Cell biology, Molecular biology, Genetics and Biochemistry	4	6	40	60	100	3
Non Credit							
18PLS101	Career competency Skills I	1	-	-	-	-	-
	Total	**30**				**600**	**28**
SECOND SEMESTER							
Part-A							
18PBTM201	Core VI: Immunology	5	3	25	75	100	5
18PBTM202	Core VII: Bioprocess Technology	5	3	25	75	100	5
	Elective I	5	3	25	75	100	4
18PBTMP201	Core Practical II: Lab in Bioprocess technology and Immunology	5	6	40	60	100	3

Optional Subjects							
18PBCBTI201	IDC I: Diagnostic Biochemistry	4	3	25	75	100	2
18PBCBTIP201	IDC Practical I: Diagnostic Biochemistry	3	3	40	60	100	2
18PMBBTI201	IDC I: Clinical Microbiology	4	3	25	75	100	2
18PMBBTIP201	IDC Practical I: Clinical Microbiology	3	3	40	60	100	2
Part- B							
18PVE201	Value Education: Human Rights	2	3	25	75	100	2
Non Credit							
18PLS201	Career competency Skills II	1	-	-	-	-	-
	Total	**30**				**700**	**23**
THIRD SEMESTER							
Part –A							
18PBTM301	Core VIII: Plant tissue and Animal cell culture technology	6	3	25	75	100	5
18PBTM302	Core IX: Genetic engineering	6	3	25	75	100	5
18PBTM303	Core X: Biostatistics and Research Methodology	5	3	25	75	100	4
18PBTMP301	Core Practical III: Lab in Plant tissue and Animal cell culture technology and Genetic Engineering	5	6	40	60	100	4

18PBTMP302	Core Practical IV: Statistical software	2	3	40	60	100	2
Optional Subjects							
18PBCBTI301	IDC II: Pharmaceutical Biochemistry	3	3	25	75	100	2
18PBCBTIP301	IDC Practical II: Pharmaceutical Biochemistry	3	3	40	60	100	2
18PMBBTI301	IDC II: Industrial Microbiology	3	3	25	75	100	2
18PMBBTIP301	IDC Practical II: Industrial Microbiology	3	3	40	60	100	2
	Total	**30**				**700**	**24**
FOURTH SEMESTER							
Part – A							
18PBTM401	Core XI: Food and Pharmaceutical Biotechnology	5	3	25	75	100	5
	Elective II	5	3	25	75	100	4
18PBTPR401	Project & Viva-Voce	4	-	50	150	200	6
	Total	**14**				**400**	**15**
					Grand Total	**2400**	**90**

ELECTIVE COURSES

The department offers the following four subjects as Elective courses for second and fourth semesters.

S.No	Subject Code	Semester	Subject
1.	18PBTEL201	II	Cell communication and Signaling
2.	18PBTEL202		Bioinstrumentation and Bioinformatics
3.	18PBTEL401	IV	Environmental Biotechnology
4.	18PBTEL402		Evolution and Biodiversity

TOTAL CREDIT DISTRIBUTION

S.NO	PART	COMPONENTS	TOTAL NUMBER OF SUBJECTS	MAXIMUM MARKS	TOTAL MARKS	CREDIT POINTS
1.	PART - A	Core Subjects	11	100	1100	55
		Core Practical	4	100	400	11
		IDC Paper	2	100	200	04
		IDC Practical	2	100	200	04
		Elective Subject	2	100	200	08
		Project	1	200	200	06
2.	PART - B	Value Education	1	100	100	02
				Total	**2400**	**90**

18PBTM101	CORE I: CELL BIOLOGY	SEMESTER - I

Course Objectives:

The Course aims

- To know about cell structure and functions and cell division.
- To know the concept of genes and its inheritance.

Credits: 5 **Total Hours:50**

UNIT	CONTENTS	Hrs	CO
I	Structure and function of prokaryotic and eukaryotic cell; single cells to multicellular organisms. Chemical components of cell, Food and the derivation of cellular energy; Membrane structure – lipid bilayer, membrane transport, transporters and active membrane transport, ion channels and electrical properties of membrane proteins.	**10**	**CO1**
II	Structure and function of cell organelles: Mitochondria and Chloroplast- Molecular events of electron transport chain, ATP synthesis, photosynthesis and photorespiration, Endoplasmic reticulum, Golgi complex, lysosomes, peroxisomes.	**10**	**CO2**
III	Cytoskeleton - Structure and functions of cytoskeletal elements: Microtubules, microfilaments and intermediate filaments. Organization and role of microtubules and microfilaments; Cell shape and motility; Actin-binding proteins and their significance; Muscle organization and function; Molecular motors; Intermediate filaments.	**10**	**CO3**
IV	The Cell Nucleus – Chromosomal DNA and packaging, Chromatin structure, genome evolution. Intracellular	**10**	**CO4**

	compartments - protein transport into mitochondria, chloroplast, peroxisome and endoplasmic reticulum. Intra cellular vesicular traffic, Cell signaling – types, Chemical signals and cellular receptors, G Protein-linked receptors, Protein Kinase-associated receptors, Growth factors as messengers.		
V	Cell division-Mitosis, Meiosis, cell cycle control system, Cell death and renewal – Programmed cell death (Apoptosis), Necrosis and regulation. Oncogenes and Tumor Suppressor Genes - pRB and p53 tumor suppressor proteins.	**10**	**CO5**

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 *Hausmam, 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*. 2008. **Molecular Biology of the Cell.** [Fifth Edition]. Garland Science, Taylor And Francis Group.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Explain the cytoskeletal activities of cell.
CO2	Differentiate the basic cellular organelles those constitute the cells.
CO3	Demonstrate the cytoskeleton system and motility of the cell
CO4	Illustrate the nuclear ingredients and its arrangements
CO5	Explain the process of cell cycle and Cell death.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	L	M	H	H
CO2	H	M	M	H	H
CO3	H	H	H	M	M
CO4	H	M	M	M	M
CO5	H	H	M	L	M

H-High; M-Medium; L-Low

18PBTM102	**CORE II: MOLECULAR BIOLOGY**	**SEMESTER -I**

Course Objectives:

The Course aims

- To know the molecular basis of cell and to obtain knowledge about various molecular mechanisms.

Credits: 5 **Total Hours: 50**

Unit	Contents	Hrs	CO
I	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 - Prokaryotic replication and Eukaryotic replication, DNA polymerases.	**10**	**CO1**
II	Mutagens and Mutations: DNA Damage and repair mechanism – Excision, recombination, mismatch and SOS repair systems. Recombination – Models for Homologous recombination and Holliday model and Transposons – types.	**10**	**CO2**
III	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 mechanisms.	**10**	**CO3**

IV	Translation –Messenger RNA, Transfer RNA, Ribosome, Initiation, elongation and termination of translation. Post translational modification, Molecular chaperones, protein targeting – Mitochondria, Nucleus, Lysosomes and Peroxisomes. Genetic code and Wobble hypothesis.	**10**	**CO4**
V	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.	**10**	**CO5**

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]. McGraw 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.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Compute with the concepts of central dogma of molecular concepts and structures of the genetic materials
CO2	Analyze the mechanism behind the mutations and repair methods in cell
CO3	Demonstrate the background of the transfer of genetic information from parent to daughter and their modification systems
CO4	Criticize the protein formations and modifications it taking for actions in cellular levels
CO5	Develop knowledge about the genetic level changes for protein and enzyme functioning

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	L	M	M	H
CO2	L	M	M	M	H
CO3	M	M	M	M	L
CO4	M	M	L	H	H
CO5	H	H	H	L	L

H-High; M-Medium; L-Low

18PBTM103	CORE III: MICROBIOLOGY AND GENETICS	SEMESTER - I

Course Objectives:

The Course aims

- To gain knowledge about basic concepts of microbiology and genetics.

Credits:5 **Total Hours:50**

UNIT	CONTENTS	Hrs	CO
I	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, Classification of Extremophiles.	**10**	**CO1**
II	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. Stains and staining technique. Determination of generation time and growth curve.	**10**	**CO2**
III	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, Culture Collection Centers and International Depository	**10**	**CO3**

	Authorities.		
IV	Mendelian genetics- Principles of segregation, Monohybrid cross, Principles of Independent Assortment – Dihybrid and trihybrid cross, Epistasis. Molecular genetics- Identification of genetic material- Griffith experiment, Avery, McLeod and McCarty experiment, Hersey and Chase experiment. Methods of gene transfer- transformation, transduction, conjugation. Gene mapping – conjugational maps, transductional maps, linkage maps, mapping using molecular markers, QTL mapping.	**10**	**CO4**
V	Population genetics- Genetic variation, the Hardy Weinberg law, Inbreeding, Outbreeding and Assertive mating, Human genetics -Pedigree analysis, Lod score for linkage testing, karyotypes, genetic disorders, Eugenics. Epigenetics & Genome Imprinting. Structural and numerical alterations of chromosomes - Deletion, duplication, inversion, translocation, ploidy and their genetic implications., Polygenetic inheritance, heritability and its measurements.	**10**	**CO5**

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.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Explain about the microbiological concepts and microbial classification techniques.
CO2	Demonstrate about Design new microbial cell culture media and its applications.
CO3	Gain knowledge about concepts of microorganisms and its resistance capability and antibiotics mode of action.
CO4	Explain about the fundamental genetics concepts and genome mapping.
CO5	Describe the importance of genetics, knowledge about solve Human genetic diseases.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	M	H	L
CO2	M	H	M	L	L
CO3	H	H	L	M	M
CO4	M	M	H	H	M
CO5	M	L	M	H	H

H-High; M-Medium; L-Low

18PBTM104	CORE IV: BIOCHEMISTRY	SEMESTER- I

Course Objectives:

The Course aims

- To learn the fundamentals of biomolecules and its function in living system.

Credits: 5 **Total Hours: 60**

UNIT	CONTENTS	Hrs	CO
I	Biochemistry – Definition, Carbohydrate – Monosaccharides, Disaccharides and Polysaccharides, structure and properties, Isomers, Epimers, Enantiomers and Anomers. Base and Buffers.	**12**	**CO1**
II	Amino acids – Classification and structure. Proteins – Structure and Classification, Lipids – Classification, Nucleic acids – Structures of nitrogenous base – Nucleotides and Nucleosides.	**12**	**CO2**
III	Concept of Metabolism and Catabolism: Glycolysis – reaction and energy yield of glycolysis, Beta oxidation of fatty acids, TCA cycle, Electron transport chain and Oxidative phosphorylation. Anabolism: Gluconeogenesis, Cholestrol biosysntesis, De novo and Salvage pathway of Purine and Pyrimidine biosynthesis.	**12**	**CO3**
IV	Enzymes- Nomenclature, Classification, properties, factors affecting enzyme activity – Substrate concentration, temperature and pH, Inhibition of enzyme activity – Competitive, noncompetitive and uncompetitive. Michaclis – Menten equation.	**12**	**CO4**

V	Vitamins – Fat and Water soluble vitamins, Hormones – Definition, Classification, biological functions and disorders of pituitary hormone (Growth hormone), Thyroid hormone, Adrenal hormone (Adrenaline), pancreatic hormone(insulin).	**12**	**CO5**

Reference Books

1. *Nelson. D* 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 Revens** Publishers.
3. *Voet. D.* and *voet, J.G.* 2011. **Biochemistry**. [Sixth edition]. John Wiley & Sons (Asia) Pvt.Ltd.
4. *Berg, J.M, L.T* and *Stryer, L.* 2007.**Biochemistry**. [Sixth Edition]. W.H. Freeman and company.
5. *Koolman, J.* and *Roelum, K.H*. 2005. **Color Atlas of Biochemistry**. [Second edition]. Thieme Stuttgart, New York.

COURSE OUTCOMES (CO)

After completion of the course, the students will be to

CO1	Demonstrate the carbohydrates and its types.
CO2	Explain about classification of protein, lipids and nucleic acid.
CO3	Explain the concept of metabolism and catabolism
CO4	Illustrate the different structure, classification and function of the activity of enzymes
CO5	Describe the types and biological function of vitamins and hormones.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	H	H	H	H
CO2	M	M	H	M	M
CO3	M	H	H	M	H
CO4	M	M	M	M	H
CO5	H	H	H	M	H

H-High; M-Medium; L-Low

18PBTM105	CORE V: DEVELOPMENTAL BIOLOGY	SEMESTER - I

Course Objectives:

The Course aims

- To study the basics of Developmental biology.

Credits:5 **Total Hours:50**

UNIT	CONTENTS	Hrs	CO
I	**Foundation of developmental Biology:** History of developmental biology, types of development, strategies in developmental biology, phase of animal development. Major molecular and cellular component of development: genes and proteins, and transcription factors and signal molecule.	10	CO1
II	**Basic mechanism of development:** Cell division – molecular view, Morphogenetic movement – morphogenesis, cellular process, cell – cell adhesion molecules, cell migration. Cell to cell interaction - induction, signal, competency. Growth – mechanism, dynamic and factors. Differentiation: Potency, specification, differentiation.	10	CO2
III	**Early embryonic development:** Fertilization – structure of gametes – sperm, the egg, - recognition of egg and sperm. External fertilization in sea urchin, internal fertilization in mammals, gastrulation in snails, development of tetrapod.	10	CO3
IV	**Organogenesis in plants:** Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in *Arabidopsis* and *Antirrhinum.*	10	CO4
V	**Sex determination and development:** chromosomal sex	10	CO5

	determination – sex determination in mammals, sex determination in drosophila. Post embryonic development – metamorphosis – amphibian and insect metamorphosis, regeneration, types of regeneration. Aging and senescence. Evolution – developmental repatterning - heterochrony, heterotopy, heterometry and heterotypy.		

Reference Books

1. *Chattopadhyay S*. 2016. **An Introduction to Developmental Biology.** [First Edition].Books and Allied (P) Ltd. Kolkata.
2. *Gilbert S.F.* 2015. **Developmental Biology**. [revised edition]. Tata McGraw publishing House.
3. *Lodish Berk, Kaiser Krieger, Scott Bretscher, Ploegh* and *Matsudair.* 2011. **Molecular cell Biology**. [Fifth Edition]. W. H. Freeman and Company, New York.
4. *Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts and Peter Walter.* 2008. **Molecular Biology of the Cell.** [Fifth Edition]. Garland Science, Taylor and Francis Group.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Explain historical perspective of Developmental biology.
CO2	Demonstrate the fundamentals of Development biology.
CO3	Differentiate gametogenesis, fertilization and early development.
CO4	Illustrate the organogenesis in plants.
CO5	Illustrate the sex determination and evolution.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	M	M	H
CO2	H	H	M	M	H
CO3	H	M	L	M	M
CO4	H	H	M	H	L
CO5	M	H	M	M	M

H-High; M-Medium; L-Low

18PBTMP101	CORE PRACTICAL I: LAB IN CELL BIOLOGY, MOLECULAR BIOLOGY, GENETICS, AND BIOCHEMISTRY	SEMESTER - I

Course Objectives:

The Course aims

- To understand the basic concepts about Cell biology, Genetics, and Biochemistry.

Credits:3 **Total Hours: 56**

S.No	EXPERIMENT	Hrs	CO
1.	Micrometry-Measurement of Cell Size (Yeast, Bacteria)	**04**	**CO1**
2.	Mitosis & Meiosis	**04**	
3.	Antimicrobial Susceptibility testing – Kirby-Bauer Diffusion Method	**04**	**CO2**
4.	Enumeration and Isolation of bacteria from soil sample.	**04**	
5.	Determination of Growth Curve by turbidity method (temperature optimization)	**04**	
6.	Biochemical test for identification of bacteria a) IMViC test b) Oxidase test c) Catalase test d) Triple Sugar Iron test	**04**	**CO3**
7.	Extraction of Genomic DNA from bacteria	**04**	**CO4**
8.	Estimation of protein (Lowry's method)	**04**	
9.	Estimation of DNA (Diphenyl amine method)	**04**	
10.	Separation of protein by SDS PAGE.	**04**	
11.	Extraction and estimation of starch from potato	**04**	
12.	Identification of amino acids by Thin-layer chromatography	**04**	

	method		**CO5**
13.	Paper chromatography	**04**	
14.	Preparation of Buffer and calibration of pH meter	**04**	

Reference Book

1. *Aneja, K.R.* 2003. **Experiments in Microbiology, Plant pathology and Biotechnology.** [Fourth Edition]. New age international.
2. *Cappucino, J.G and Sherman, N.* 2012. **Microbiology – A laboratory manual.**[Seventh Edition]. Pearson Education Inc.
3. ***Rajan. S*** *and Selvi Christy R.* 2015. Experimental Procedures in Life Sciences. [First Edition]. Anjanaa Book House, Chennai – 600 107.
4. *Janarthanan,S. and Vincent,S.*2009. **Practical Biotechnology: Methods and Protocols.** [Second Edition]. Universities press, (India) Pvt Ltd, Hyderabad.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Measure the cell size and to perform mitosis and meiosis.
CO2	Perform antimicrobial Susceptibility testing and also can isolate bacteria as well as determine the growth curve.
CO3	Perform various biochemical tests.
CO4	Isolate and estimate the amount of DNA and protein.
CO5	Do Thin layer chromatography, Paper chromatography and also can calibrate pH meter.

18PLS101	CAREER COMPETENCY SKILLS I	SEMESTER – I

Course Objectives:

The Course aims

- To impart knowledge on the Aptitude.
- To enhance employability skills and to develop career competency.

Total Hours: 15

UNIT	CONTENTS	Hrs	CO
I	Solving Simultaneous Equations Faster – Number System : HCF, LCM – Square roots and Cube roots - Averages	**03**	**CO1**
II	Problems on Numbers –Problems on Ages	**03**	**CO2**
III	Calendar – Clocks – Pipes and Cisterns	**03**	**CO3**
IV	Time and Work – Time and Distance	**03**	**CO4**
V	Ratio and Proportion – Partnership – Chain Rule	**03**	**CO5**

Text Book

1	*Aggarwal R.S. 2013.* **Quantitative Aptitude. [Seventh Revised Edition].** S.Chand & Co., New Delhi.

Reference Book

1	*Abhijith Guha,* **Quantitative Aptitude for Competitive Examinations**, 5th Edition, Tata McGraw Hill, 2015, New Delhi.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Carry out mathematical calculations using shortcuts.
CO2	Calculate Problems on Ages with shortcuts.
CO3	Understand the core concepts of Pipes & Cisterns, Calendar & Clocks.
CO4	Obtain knowledge on shortcuts to Time & Work and Time & Distance.
CO5	Calculate Ratio & Proportion, Partnership with shortcuts.

18PBTM201	CORE VI: IMMUNOLOGY	SEMESTER- II

Course Objectives:

The Course aims

- To study the basic principles of immunology and molecular mechanisms.

Credits:5 **Total Hours:50**

UNIT	CONTENTS	Hrs	CO
I	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.	10	CO1
II	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.	10	CO2
III	Complement proteins and pathways. Cell mediated immune response – T cell maturation, activation and differentiation, Cytokines; properties, types. Humoral immune response – B cell generation, activation & differentiation. Primary and Secondary humoral immune response.	10	CO3

IV	Hypersensitivity reactions, Immunodeficiency - Primary and Secondary immunodeficiency. Autoimmunity - Organ specific and Systemic autoimmunity. Transplantation- Immunological aspects of graft rejection Vaccines, types and vaccination.	**10**	**CO4**
V	Antigen – antibody interaction; Agglutination, Precipitation, Immunoelectrophoresis, ELISA, Western blot, Immunofluorescence. Hybridoma technology, FACs, HLA typing.	**10**	**CO5**

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.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Describe the features of cells and tissues of the immune system and differentiate immunogens, antigens, haptens and adjuvants with respect to immunological functions.
CO2	Explain about the structure of immunoglobulin and apply the mechanism of biology of antigen processing and presentation.
CO3	Illustrate the developmental behaviors of B cells and study antigen and antibody interaction.
CO4	Describe the injury and inflammation and the broad education necessary to understand AIDS. And understand the mechanism of immune responses with respect to transplantation and graft rejection.
CO5	Identify modern techniques to analyze tumor antigens and study autoimmune diseases. And to develop the monoclonal antibodies through hybridoma technology for humoral immunity.

MAPPING

PSO / CO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	H	M	M	M	L
CO2	M	M	H	L	L
CO3	M	L	L	M	H
CO4	L	M	H	M	H
CO5	L	M	L	H	M

H-High; M-Medium; L-Low

18PBTM202	CORE VII: BIOPROCESS TECHNOLOGY	SEMESTER - II

Course Objectives:

The Course aims

- To learn about the various bioprocess and engineering technology and to implement in industries.

Credits: 5 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	Isolation of industrially important microbes, Primary and Secondary Screening and Assay of fermentation products. Preservation of important strain for increased yield and other desirable characters. An overview of aerobic and anaerobic fermentation process. Fermentation: Submerged and solid state fermentation and immobilization.	10	CO1
II	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, Airlift, Bubble column, packed bed.	10	CO2
III	Mass Transfer – Introduction to mass transfer between phases, Gas – liquid mass transfer in cellular system, liquid – Solid mass transfer, 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.	10	CO3
IV	Bioprocess control and monitoring Methods of measuring process variables such as Temperature, Agitation,	10	CO4

	Pressure, pH and foam. Online measurement, Control system: manual and automatic control, On/Off controls and PID control. Computer application in fermentation technology.		
V	Separation of microbial cells and suspended solids. Intra cellular product recovery: Cell distruption – Physical and Chemical method, Ultrasonication, Centrifugation, membrane process, Chromatography, Electrophoresis, Solvent extraction, Distillation, Crystallization, Evaporation and drying.	**10**	**CO5**

Text Book

1	*Stanbury. P.R and Whitaker*, 2002.**Principles of fermentation technology**. Elsevier Science Ltd.

Reference Books

1	*Pauline M Doran*.1995.**Bioprocess Engineering Principles**. Academic press.
2	*Shuler M.L. and Kargi F*. 2004. **Bioprocess Engineering**: Basic concept [Second Edition].Prentice Hall. Pvt. Ltd., New Delhi.
3	*Patel A.H.* 2005. **Industrial Microbiology**. [Fifth edition].MacMillan Indian Ltd. New Delhi.
4	*Crueger, W.* and *Crueger, A*. 2002. **A Text book of Industrial Microbiology**.[Second Edition]. Science tech Publishers, USA

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Apply the basic knowledge of fermentation process.
CO2	Explain about Overview of the medium for industrial fermentation and Growth kinetics.
CO3	Demonstrate the different phases of mass transfer.
CO4	Describe about the different bioprocess control and monitoring methods.
CO5	Explain the separation process of microbial cells from various techniques.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	M	M	M
CO2	M	H	M	M	M
CO3	M	H	H	H	M
CO4	M	M	H	M	H
CO5	M	H	H	H	H

H-High; M-Medium; L-Low

18PBTEL201	ELECTIVE I: CELL COMMUNICATION AND SIGNALING	SEMESTER - II

Course Objectives:

The Course aims

- To gain knowledge about basics about the Cell signaling and cell communication.
- To learn about the pharmaceutical biotechnology and cancer immunology.

Credits: 4 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	Host parasite interaction: Recognition and entry processes of different pathogens like bacteria, viruses into animal and plant host cells, alteration of host cell behavior by pathogens, virus-induced cell transformation, pathogen-induced diseases in animals and plants, cell-cell fusion in both normal and abnormal cells.	10	CO1
II	Cell signaling: Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two component systems, light signaling in plants, bacterial chemo taxis and quorum sensing.	10	CO2
III	Cellular communication: Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation.	10	CO3

IV	Toll-like receptors, Cytokines receptors, Leukocyte migration - Cell adhesion molecules, Neutrophil extravasation, Lymphocyte extravasation. Cell-mediated effector functions, immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections.	**10**	**CO4**
V	Cancer: Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth.	**10**	**CO5**

Reference Books

1. *Gerald Karp.*, 2010. **Cell Biology**. [Sixth Edition]. John wiley and Sons (Asia) Pvt. Ltd.
2. *Geoffrey M. Cooper and Hausman, R.E.*, 2007. **The Cell - A Molecular Approach**. [Fourth Edition]. ASM Press, Washington, D.C.
3. *Lodish Berk, Kaiser Krieger, Scott Bretscher, Ploegh* and *Matsudair.* 2011. **Molecular cell Biology**. [Fifth Edition]. W. H. Freeman and Company, New York.
4. *Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts and Peter Walter.* 2008. **Molecular Biology of the Cell.** [Fifth Edition]. Garland Science, Taylor and Francis Group.
5. *Kuby Richard. A. Goldsby, Thomas. J. Kint* and *Barbara. A. Osborne.* 2000. **Immunology** [Fourth Edition]. W.H. Freeman and Company, New York.
6. *Kalus D. Elgert.* 2009**. Immunology - Understanding the Immune System.** [Second Edition]. Wiley-Blackwell Publication.

7	*Kenneth Murphy, Paul Travers and Mark Walport,* 2008. **Janeway's Immunobiology.** [Seventh Edition]. Garland Science Taylor and Francis Group, New York.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Apply the basic knowledge of Host parasite interaction.
CO2	Explain about cell signaling.
CO3	Describe about cell communication.
CO4	Demonstrate the types of receptors and immune response during microbial infection.
CO5	Explain about cancer.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	M	L	L
CO2	M	H	M	L	L
CO3	H	M	L	M	H
CO4	H	M	H	M	M
CO5	M	L	M	H	H

H-High; M-Medium; L-Low

18PBTEL202	ELECTIVE I: BIOINSTRUMENTATION AND BIOINFORMATICS	SEMESTER - II

Course Objectives:

The Course aims

- To gain knowledge about basic concept and analytical techniques in Bioinstrumentation and Bioinformatics

Credits: 4 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	Microscopy: principle, working and application - 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. Microscopic measurement of microorganisms – Micrometry. Centrifuges - low and high speed, ultra centrifuges.	10	CO1
II	Principles, Techniques and applications of Paper, AGE and SDS PAGE. Separation Techniques - Principles, Techniques and applications of Paper Chromatography, TLC, Ion exchange Chromatography, Affinity Chromatography,LC-MS, GC-MS/MS, NMR, Isoelectric focusing	10	CO2
III	Beer Lambert's law - Principles, working and biological applications of Colorimeter, UV – VIS Spectroscopy, IR And Raman Spectroscopy, Atomic Absorption Spectroscopy, Spectrofluorometer, XRD.	10	CO3
IV	Bioinformatics – Basics, Applications. Biological Database – Classification, scheme, GENBANK, SwissProt and PDB. Sequence Alignment – Concept of Alignment, Pairwise	10	CO4

	Alignment: Principle, methods and Alignment with BLAST.		
V	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.	**10**	**CO5**

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.
7. *Rickwood D*. and *Hames B. D.* 1990. **Gel electrophoresis of Nucleic acids.** [Second Edition]. Oxford university press**.**

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Maintain the instruments with care and know the working principles of each basic laboratory instruments.
CO2	Gain knowledge about the separation process using electrophoresis and chromatographic techniques.
CO3	Handle the instruments and measure OD value, Absorbance and concentration of specific constituents present in the unknown sample.
CO4	Interpret the biological data in computational methods & tools for solving research problems easily.
CO5	Predict the gene structure and also construct phylogenetic tree for studying the similarity and evolutionary relationship within the organism.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	M	L	L
CO2	H	H	L	M	L
CO3	H	M	L	M	H
CO4	L	L	H	M	M
CO5	L	L	M	H	L

H-High; M-Medium; L-Low

18PBTMP201	CORE PRACTICAL II: LAB IN BIOPROCESS TECHNOLOGY AND IMMUNOLOGY	SEMESTER - II

Course Objectives:

The Course aims

- To understand the basic concepts about Cell biology, Genetics, and Biochemistry.

Credits:3 **Total Hours: 45**

S.No	EXPERIMENT	Hrs	CO
1.	Enzyme production using fermenter (Amylase/ Protease)	**05**	**CO1**
2.	Cell disruption	**05**	
3.	Purification of protein by ammonium sulphate precipitation and Salting-out by Dialysis method	**05**	**CO2**
4.	Cell immoblization	**05**	
5.	Wine production using and estimation of alcohol by potassium dichromate method	**05**	**CO3**
6.	ABO grouping	**05**	
7.	WIDAL Test (Slide and Tube methods)	**05**	
8.	Antigen-Antibody interaction a. Ouchterlony Double Diffusion b. Radial Immunodiffusion c. Immunoelectrophoresis d. Counter Current Immunoelectrophoresis	**05**	**CO4**
9.	Enzyme Linked Immunosorbent Assay (ELISA)	**05**	**CO5**

Reference Book

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.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Produce the enzymes and disrupt the cells.
CO2	Purify the protein and immobilize cells.
CO3	Produce and estimate the amount of Wine and can perform ABO grouping and Widal test.
CO4	Show Antigen-Antibody interaction.
CO5	Perform Enzyme Linked Immunosorbent Assay (ELISA).

18PBCBTI201	INTERDISCIPLINARY COURSE I: DIAGNOSTIC BIOCHEMISTRY	SEMESTER–II

Course Objectives:

The Course aims

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

Credits: 2 **Total Hours: 40**

UNIT	CONTENTS	Hrs	CO
I	**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	08	CO1
II	**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	08	CO2
III	**Urine analysis and Stool examination:** Physicochemical characteristics of urine, preservation of specimen, gross examination of urine and chemical examination of urine-tests for glucose, proteins, aminoacids, ketone bodies, bile salts, bile pigments. Stool examination – Specimen collection, test	08	CO3

	for occult blood, microscopic examination of stool.		
IV	**Clinical Chemistry and Enzymology:** Diabetes Mellitus - Introduction, screening tests, diagnostic tests - insulin tolerance test. Estimation of glucose in blood, GTT, and glycosylated haemoglobin. Estimation and interpretation of cholesterol, urea, creatinine and protein in biological samples. Enzymology – Role of Alkaline and Acid phosphatase in diagnosis of diseases.	**08**	**CO4**
V	**Organ function tests:** Liver function test: Functions of the Liver, Tests based on abnormalities of bile pigments (Jaundice). Renal Function: Functions of the kidney, clearance test (Creatinine and urea), dilution test, phenol red test, principles of precise tests of renal function – Glomerular filtration rate, renal plasma flow and maximal tubular capacity	**08**	**CO5**
Text Book			
1	*Ramnik Sood.* 2006. **Medical Laboratory Technology.** [First Edition].Jaypee Brother's Medical Publishers Ltd., New Delhi		
2	*KanaiL. Mukherjee.* 2005. **Medical Laboratory Technology, Volume I.** Tata McGraw- Hill Publishing Co. New Delhi		

COURSE OUTCOMES (CO)

After the completion of the course the student will be able to

CO1	Practice the safe laboratory processes and reagent preparations
CO2	Explain the general concepts of specimen handling methods and analysis of blood cells in clinical labs
CO3	Recite the handling and analytical procedures of urine and stool samples
CO4	Describe the general concepts in diagnosis of diabetes mellitus
CO5	Perform various laboratory procedures to assess the functional status of the organs

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	L	H	H
CO2	H	M	L	H	H
CO3	H	M	L	H	H
CO4	H	M	L	H	H
CO5	H	M	L	H	H

H-High; M-Medium; L-Low

18PBCBTIP201	IDC PRACTICAL I: DIAGNOSTIC BIOCHEMISTRY	SEMESTER – II

Course Objectives:

The Course aims

- To enable the students to develop practical knowledge in handling and testing the biological samples

Credits: 2 **Total Hours: 24**

S.No.	EXPERIMENT	Hrs	CO
I. Clinical haematology			
1.	Enumeration of WBC and RBC	3	1
2.	Estimation of haemoglobin (Sahli's method)	3	1
3.	Erythrocyte sedimentation rate (Westergren's method)	3	1
II. Blood analysis			
4.	Estimation of glucose in blood (Nelson Somogyi's method).	3	2
5.	Estimation of urea in blood (DAM method).	3	2
6.	Estimation of creatinine in blood (Jaffe's method).	3	2
III. Urine analysis			
7.	Estimation of creatinine in urine (Jaffe's method).	3	2
8.	Qualitative analysis of normal and abnormal constituents in urine	3	3

Reference Books

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

COURSE OUTCOMES (CO)

After the completion of the course the student will be able to

CO1	Perform blood cell analysis procedures.
CO2	Estimate the presence of metabolites in blood and urine..
CO3	Use the tests to identify normal and abnormal constituents in urine by qualitative analysis.

18PMBBTI201	INTERDISCIPLINARY COURSE I: CLINICAL MICROBIOLOGY	SEMESTER – II

Course Objectives:

The course aims

- To enable the learners to know basics in clinical microbiology.
- To learn the diagnosis of infectious diseases.
- To know about the modern approaches in clinical microbiology.

Credits: 2 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	Infection -sources of infection - transmission of infection - types of infection. Classification of microbes based on hazard –Types of diseases - disease carriers.	08	CO1
II	Collection and transport of clinical specimens-urine, pus, faeces, sputum and blood.	08	CO2
III	Microbiological examination of sputum, pus, faeces and urine. Diagnosis of anaerobic infections.	08	CO3
IV	Serological diagnosis of microbial diseases: Antigen tests-Agglutination test for pregnancy, Elek's gel precipitation test, ELISA. Antibody tests - WIDAL, ASO. Monoclonal antibodies in clinical microbiology.	08	CO4
V	Molecular diagnosis of infectious diseases - tuberculosis, malaria, AIDS. RFLP as a molecular marker in disease diagnosis.	08	CO5

Text Book

1 *Ananthanarayan,R. and JayaramPaniker, C.K.*2008.**Textbook of Microbiology**. [Seventh edition]. University Press (India) Private Limited, Hyderabad.

2 *Monica Cheesbrough* 1994. **Medical Laboratory Manual for Tropical**

	countries.
3	Volume II: Microbiology. ELBS Publishers. *Sathyanarayana, U*. 2010. **Biotechnology**. Books and Allied (P) Ltd, Kolkatta.
Reference Book	
1	*Jawetz,E, Melnic,J.K. and Adelberg, E.A*. 1998. Review of Medical Microbiology, Lange Medical Publications, U.S.A.

COURSE OUTCOMES (CO)

After the completion of the course the student will be able to

CO1	Evaluate the infectious disease caused by microorganisms.
CO2	Apply the methods of collection and processing of clinical samples.
CO3	Apply the preliminary detection of pathogens for disease diagnosis.
CO4	Assess the serological detection of pathogens.
CO5	Develop diagnose the disease based on molecular methods.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	H	H
CO2	M	H	H	H	H
CO3	M	M	H	H	H
CO4	M	M	H	H	H
CO5	H	H	H	H	H

H-High; M-Medium; L-Low

18PMBBTIP201	**IDC PRACTICAL I: CLINICAL MICROBIOLOGY**	**SEMESTER – II**

Course Objectives:

The Course aims

- To learn the basic techniques in clinical microbiology.
- To acquire knowledge on identification of clinical pathogens.

Credits: 2 **Total Hours:20**

EXPERIMENT	**CONTENTS**	**Hrs**	**CO**
1.	Colony morphology of pathogenic bacteria on selective media.	**03**	**CO1**
2.	Morphological characterization of pathogenic bacteria by differential staining.	**02**	**CO1**
3.	Identification of pathogenic bacteria by preliminary test, biochemical test and special test. a)*Staphylococcus aureus* b) *Pseudomonas aeruginosa*	**05**	**CO1**
4.	Culture methods of fungi i. Media usage–PDA, SDA, Corn meal agar	**05**	**CO2**
5.	Examination of fungi by Lactophenol cotton blue stain.	**05**	**CO2**
6.	Examination of *Candida albicans* - Gram's stain, Germ tube test.	**05**	**CO2**

Reference Books

1	*Gerald Collee, J. Barie P.Marmion, Andrew, G. Fraser and Anthony Simmons*. 1996. **Mackie and MacCartney Practical Medical Microbiology.** Fourteenth edition. Churchill Livingstone Publishers.

2	*Sundararaj, T.* **Microbiology Laboratory Manual.** Dr.A.L.Mudaliyar Post Graduate Institute of Basic Medical Sciences, Chennai.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Identify and detect the pathogenic bacteria based on the morphological and physiological studies.
CO2	Evaluate the mycological diseases.

18PVE201	VALUE EDUCATION: HUMAN RIGHTS	SEMESTER - II

Course Objectives

The Course aims

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

Credits: 2 **Total Hours: 25**

UNIT	CONTENTS	Hrs	CO
I	**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.	05	CO1
II	**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.	05	CO2
III	**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.	05	CO3

IV	**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.	**05**	**CO4**
V	**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.	**05**	**CO5**
Reference Books			
1	*Paul Singh.* **Human Rights and Legal System.** Himalaya Publishing House, New Delhi.		

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Understand the core principles of human rights philosophy
CO2	Know the importance and functions of human rights commission
CO3	Apply their rights for democracy, human rights and gender equality
CO4	Know the rights from the Governance, economic and social development through various Acts
CO5	Understand the right to information Act, rights for women, children, Nomads, refugees and various sector of people in our country

18PLS201	CAREER COMPETENCY SKILLS II	SEMESTER – II

Course Objectives:

The Course aims

- To enhance employability skills and to develop career competency.

Total Hours: 15

UNIT	CONTENTS	Hrs	CO
I	Interview Skills – Types of Interview – Groundwork before Interview – Abide by the dress code – Importance of Body language in Interviews – Tell Us about yourself – Do's and Don'ts of an interview – Concluding an Interview – A Mock Interview.	**03**	**CO1**
II	Resume Preparation – Difference between a Resume and CV – The main body of Resume – The Career objective in Resume – A Fresher's Resume – Antiquity of Soft Skills – Classification of Soft Skills – Personality Analysis – Interpersonal Skills.	**03**	**CO2**
III	Body Language – Emotion displayed by Body Language – Group Discussion – Group Discussion types – Guidelines Do's and Don'ts during a Group Discussion – Concluding the Discussion – The technique of Summing Up.	**03**	**CO3**
IV	Speaking Skills – Effective Speaking Guidelines – Reading Skills – Types of Reading Skills – Barriers to Speed Reading – Listening Skills – Stages of Listening – Types of Listening – Barriers to Listening – Beware of Pitfalls – Avoid Errors : Indianisms in English – Most common errors in the world – Similar but not Quite the same – Words that are Singular or Couple.	**03**	**CO4**

V	Avoid Pitfalls: of Beware Self-improvement - Facilitating Laboratory: Language Techniques and Concepts E-learning	**03**	**CO5**
Text Book			
1	*Barun K. Mitra. 2011.* **Personality Development and Soft skills**. [Second Edition]. Oxford University Press, New Delhi.		
Reference Book			
1	*S.P. Dhanavel. 2015,* **English and Soft Skills**. [Second Edition]. Orient Black Swan Publishers, New Delhi.		

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Understand the types of Interviews, Dress Code and Styles
CO2	Develop Resume content and structures.
CO3	Improve body language skills.
CO4	Know how to represent self through communication.
CO5	Attain the different level of Learning Skills.

18PBTM301	CORE VIII: PLANT TISSUE AND ANIMAL CELL CULTURE TECHNOLOGY	SEMESTER - III	
Course Objectives: The Course aims • To acquire the knowledge about physiology, stress response and secondary metabolites by the plants. • To apply the knowledge of Plant tissue and Animal cell culture techniques.			
Credits: 5		**Total Hours: 50**	
UNIT	**CONTENTS**	**Hrs**	**CO**
I	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, cytoplasmic male sterility.	**10**	**CO1**
II	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.	**10**	**CO2**
III	Biosynthesis of Alkaloids, flavanoids, anthocyanins, phenols and their medical applications. Physiological effects and mechanism	**10**	**CO3**

	of action of the auxins, cytokinins, gibberllins and abscissic acid. Biosynthesis and function of ethylene.		
IV	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.	**12**	**CO4**
V	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, MTT, cytotoxicity and cell viability assays.	**08**	**CO5**
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 Cells: A Manual of Basic Technique.** [Fifth Edition]. John Wiley and Sons, New Jersey.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Distinguish the cells and organs of the plants and stress management by the plants.
CO2	Explain about different types of culture techniques and to experiment with them.
CO3	Differentiate the functions of phytohormones and phytochemicals.
CO4	Handle the equipments used in Animal Cell culture technology.
CO5	Attain the knowledge on culturing of animal cell lines.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	M	L	L
CO2	H	M	H	L	M
CO3	H	M	H	M	H
CO4	M	L	H	L	L
CO5	H	L	H	L	M

H-High; M-Medium; L-Low

18PBTM302	CORE IX: GENETIC ENGINEERING	SEMESTER - III

Course Objectives:

The Course aims

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

Credits:5 **Total Hours:50**

UNIT	CONTENTS	Hrs	CO
I	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.	**10**	**CO1**
II	Bacterial vectors- pBR322 and pUC vectors. Phage vectors – Lambda, M13 and Cosmid. Artificial chromosomes – YAC, BAC, PAC and HAC, Expression vectors and Shuttle vectors. Host cell types and transformation.	**10**	**CO2**
III	Cloning strategies – Gene library construction – Genomic and cDNA libraries. DNA cloning – Homopolymer tailing and use of adapters and linkers with ligase. Screening and analysis of recombinants – radiolabeled and non-radiolabeled probes. Blotting techniques – Southern/Northern/Western.	**10**	**CO3**

	Immunological screening of expressed genes.		
IV	His tag biotin- avidin and Gene Expression in *E. coli, Saccharomyces cerevisiae,* Expression in insect cells, higher eukaryotic system – Tet On/Off systems, Phage display.	**10**	**CO4**
V	DNA sequencing – Chemical, enzymatic and automated DNA sequencing, Pyro sequencing and NGS sequencing methods. Microarrays – Principles and applications. PCR – Principle, types and applications, Real time PCR, Site directed mutagenesis and Protein engineering. Gene therapy, Gene knockout technologies	**10**	**CO5**

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.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Describe the types of enzymes used in genetic engineering.
CO2	Demonstrate the types of vectors used in genetic engineering and different strains used.
CO3	Explain about the construction of gene libraries and screen the recombinants.
CO4	Apply the various strategies involved in gene cloning.
CO5	Apply their knowledge in the genetic engineering application.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H`	L	L	M
CO2	H	M	M	L	H
CO3	M	H	M	M	L
CO4	H	H	M	M	H
CO5	H	H	L	M	H

H-High; M-Medium; L-Low

<table>
<tr><td colspan="2">18PBTM303</td><td colspan="2">CORE X: BIOSTATISTICS AND RESEARCH METHODOLOGY</td><td>SEMESTER – III</td></tr>
<tr><td colspan="5">Course Objectives:
The Course aims
• To learn the strategies of research field and also to provide knowledge to understand the role of statistics in research.</td></tr>
<tr><td colspan="3">Credits: 4</td><td colspan="2">Total Hours: 50</td></tr>
<tr><td>UNIT</td><td colspan="2">CONTENTS</td><td>Hrs</td><td>CO</td></tr>
<tr><td>I</td><td colspan="2">Statistics: Introduction – Definition of Statistics – Functions of Statistics – Applications and Limitations of Statistics.
Collection of data: Primary and Secondary Data – Methods of Collecting Primary Data – Sources of Secondary Data.
Classification and Tabulation of data: Types of Classification – Tabulation of Data – Parts of a Table - Types of Tables.
Diagrammatic and Graphical Representation: Types of Diagrams – Graphs – Graphs of Frequency Distributions.
Measures of Central Tendency: Arithmetic Mean (except weighted mean and corrected values) – Median – Mode – Merits and demerits.
(Volume 1: Chapters 1, 3, 5, 6 and 7)</td><td>10</td><td>CO1</td></tr>
<tr><td>II</td><td colspan="2">Measures of Dispersion: Mean Deviation – Standard Deviation – Coefficient of Variation.
Correlation Analysis: Types of Correlation – Methods of Correlation - Karl Pearson’s Coefficient – Rank Correlation Coefficient.</td><td>10</td><td>CO2</td></tr>
</table>

	Regression Analysis: Regression Lines – Regression Equations. **(Volume 1: Chapters 8, 10 and 11)**		
III	**Test of Hypothesis:** Population – Sample – Procedure of Testing Hypothesis – Types of errors – Standard Error - t test – F test - Chi-square Test of Independence of Attributes. **Analysis of Variance:** One way Classification – Two way Classification. **(Volume 2: Chapter 3, 4 and 5)**	**10**	**CO3**
IV	**Research**– Planning and Classification, Components of research report, Essential steps in research. Problem Identification& Formulation, Research Question, **Hypothesis**- Qualities of a good Hypothesis, Null Hypothesis& Alternative Hypothesis. Experimental design. Literature collection – and its importance.	**10**	**CO4**
V	Preparing proposal for a research project. Scientific Research report writing– writing Introduction, Review of literature, Materials and methods, Results, Table, Figures, Discussion, Citing and listing references. Format of a Thesis. Preparation of manuscript for publication. Scientific information-Introduction, Writing proposals, scientific papers and figures. Plagiarism.	**10**	**CO5**
Text Books			
1	*Gupta, S.P.* 2008. **Statistical Methods.** Sultan Chand and Sons Publishers, New Delhi. **(UNITS I – III)**		
2	*Gurumani, N.*2006. **Research Methodology**. MJP Publishers. (**UNIT IV**).		
3	*Gurumani*, N. 2016. Scientific thesis writing and paper presentation. MJP Publishers. (**UNIT V**)		

Reference Books	
1	*Gurumani, N.* 2008. **An introduction to Biostatistics.** [Second edition], MJP Publishers, Chennai.
2	*Antonisamy, B., Solomon Christopher and Prasanna Samuel.* 2010. **Biostatistics: Principles and Practice**. Tata McGraw Hill Education Private Limited, New Delhi.
3	*Padmini E.*2007.**Biochemical Calculations & Biostatistics**. [First Edition]. Books and Allied (P) Ltd., Kolkata.
4	*Kothari,C.R.* 1990. **Research Methodology–Methods and Techniques**. New Age Publications. New Delhi

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Learn the importance of statistics and Understand the concepts of measures of central tendency and measures of dispersion
CO2	Gain knowledge on correlation and regression analyses
CO3	Test the research statements through ANOVA.
CO4	Select the appropriate procedure for carrying out their research work
CO5	Understand the concepts in writing thesis, proposal and result interpretation

MAPPING

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	L	H	M	H	H
CO2	L	M	L	H	H
CO3	L	H	M	H	H
CO4	H	M	H	H	H
CO5	H	M	M	H	H

H-High; M-Medium; L-Low

18PBTMP301	CORE PRACTICAL III: LAB IN PLANT TISSUE ,ANIMAL CELL CULTURE TECHNOLOGY AND GENETIC ENGINEERING	SEMESTER -III

Course objectives:

The Course aims

- To learn the various techniques used in Plant tissue, Animal cell technology and Genetic engineering.
- To isolate the DNA, Restrict and amplify the DNA.
- To culture the plant and animal tissues.

Credits:4 **Total Hours: 60**

S.No	EXPERIMENT	Hrs	CO
1.	Isolation of Genomic DNA from Bacteria	**05**	**CO1**
2.	Isolation of plasmid DNA	**05**	
3.	Restriction Digestion and Ligation	**05**	**CO2**
4.	Polymerase Chain Reaction	**05**	
5.	Bacterial Transformation	**05**	
6.	Media preparation for Animal Cell Culture	**05**	**CO3**
7.	Primary and secondary culture of animal cells	**05**	
8.	Determination of viability of cells using Trypan blue stain	**05**	
9.	Preparation of media for Plant Tissue Culture	**05**	**CO4**
10.	Selection and sterilization of explants for callus induction	**05**	
11.	Micropropagation	**05**	
12.	Isolation of plant DNA by CTAB method	**05**	**CO5**

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.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Do isolation of genomic DNA and plasmid DNA.
CO2	Produce DNA fragments, amplify the DNA and also can perform bacterial transformation.
CO3	Prepare media for culturing of animal cells, culture the animal cell lines and also can determine the viability of animal cells.
CO4	Prepare media for plant tissue culture and also can perform callus induction and micropropagation.
CO5	Isolate plant genomic DNA.

18PBTMP302	**CORE PRACTICAL IV: STATISTICAL SOFTWARE**	**SEMESTER – III**

Course Objectives:

The Course aims

- To give a good grip on concepts in analyzing the data using statistical software

Credits: 2 **Total Hours: 24**

PROGRAM	CONTENTS	Hrs	CO
1	Diagrams and graphs	**03**	**CO1**
2	Measures of Central Tendency	**03**	**CO2**
3	Measures of Dispersion	**03**	
4	Correlation Coefficient (Karl Pearson and Spearman Rank Method)	**03**	**CO3**
5	Regression lines	**03**	
6	Small Sample Test (t and F)	**03**	**CO4**
7	Chi-square Test for Independence of Attributes.	**03**	
8	ANOVA (one way and two way classification)	**03**	

Reference Book

1 *Shentan J. Coakes, Lyndall Steed and Peta Dzidic.* **SPSS 13.0 version for Windows analysis without Anguish.** John Wiley & Sons, Australia.

2 *Andy Field.* 2006. **Discovering Statistics using SPSS.** [Second Edition]. SAGE Publications.

COURSE OUTCOMES (CO)

After completion of this course, the students will be able to

CO1	Demonstrate the data in diagrammatic and graphical representation.
CO2	Find the averages and measures dispersion.
CO3	Calculate correlation and regression for huge amount data.
CO4	Gain knowledge about test of significance and can analyze clinical data.

18PBCBTI301	INTER DISCIPLINARY COURSE II: PHARMACEUTICAL BIOCHEMISTRY	SEMESTER–III

Course Objectives:

The Course aims

- Pharmacodynamics and pharmacokinetics of drugs.
- Plant therapeutics

Credits: 2 **Total Hours: 40**

UNIT	CONTENTS	Hrs	CO
I	**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	08	CO1
II	Distribution and elimination of drugs. Factors influencing drug distribution and elimination. Mechanism of drug action- Physical, Chemical, Enzymes, Receptors. Drug-Receptor interactions: Receptor – Definition. Agonists, partial aganoists, inverse agonists and antagonists. Forces involved in drug-receptor interaction. Drug action not mediated through receptor. Dose response relationship (LD50 and ED50)	08	CO2
III	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)	08	CO3

IV	Phytomedicine: History, Definition and Scope of Phytomedicine. Indian Medicinal systems– Ayurveda, Siddha and Unani. Medicinal properties and active principles of plant parts (leaves, flowers, roots, seeds, rhizome, bark etc). Role of medicinal and aromatic plants in national economy.	**08**	**CO4**
V	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 (soxhlet) extraction - Analysis of phytochemicals (carbohydrates, aminoacids, proteins, phenols, flavonoids, alkaloids tannins, glycosides, saponins and terpenoids).	**08**	**CO5**
Text Books			
1	*Tripathi, K. D*. 1999. **Essentials of MedicalPharmacology.** [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]. NiraliPrakasham, 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		

COURSE OUTCOMES (CO)

After the completion of the course, the student will be able to

CO1	Describe the drug sources, classification and its pharmacodynamics
CO2	Explain the mechanisms of action and fate of drugs inside living organisms
CO3	Analyze the effects of adverse drug reactions
CO4	Appreciate the various medical systems that utilize phytoconstituents as medicines
CO5	Explore the new strategies in the development of efficient drugs to combat diseases from plants

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	M	H	H
CO2	H	M	M	H	H
CO3	H	M	M	H	H
CO4	H	M	M	H	H
CO5	H	M	M	H	H

H-High; M-Medium; L-Low

18PBCBTIP301	INTER DISCIPLINARY COURSE PRACTICAL II: PHARMACEUTICAL BIOCHEMISTRY	SEMESTER – III

Course Objectives:

The Course aims

- To enable the students to understand the basic concepts in extraction, screening, quantification process of secondary metabolites

Credits: 2 **Total Hours: 24**

S.No.	EXPERIMENT	Hrs	CO
1.	Extraction of phytoconstituents of neem leaves using water and methanol as solvents- Maceration and Soxhlet extraction	**03**	**CO1**
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 (xi) Glycosides (x) Saponins	**06**	**CO1**
3.	Quantitative estimation of proteins (Lowry's method).	**03**	**CO2**
4.	Quantitative estimation of carbohydrates (Anthrone method).	**03**	**CO2**
5.	Quantitative estimation of phenols (Singleton and Rossi's method).	**03**	**CO2**
6.	Isolation and partial purification of phytoconstituents (Phenol	**06**	**CO2**

	and Flavonoids) using Chromatographic techniques (TLC)		
Reference Books:			
1	*Kokate, C.K., Purohit, A.P.* and*Gokhale, S.B.* 2008. **Phytochemical Methods.** Nirali Prakasham, Pune		

COURSE OUTCOMES (CO)

After the completion of the course the student will be able to

CO1	Extract and screen the presence of various plant metabolites.
CO2	Quantify the presence of biomolecules and secondary metabolites in samples.

18PMBBTI301	INTER DISCIPLINARY COURSE II : INDUSTRIAL MICROBIOLOGY	SEMESTER – III

Course Objectives:

The Course aims

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

Credits: 2 **Total Hours: 40**

UNIT	CONTENTS	Hrs	CO
I	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 processes.	**08**	**CO1**
II	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.	**08**	**CO2**
III	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.	**08**	**CO3**
IV	Microbial production of fermented products – Wine. Organic acid – Citric acid and Lactic acids. Vitamin –	**08**	**CO4**

	Vitamin B12. Enzyme – α-amylase.		
V	Microbial production of antibiotic – Penicillin - Streptomycin; Vaccines – BCG; Toxoid – Tetanus Toxoid – Preparation of antisera.	**08**	**CO5**
Text Books			
1	*Stanbury, P.F., Whitaker, A., and Hall, S.J.,* 2005. **Principles of Fermentation technology.** Reed Elsevier India Ltd., New Delhi.		
2	*Patel, A.H.,* 2005. **An Introduction to Industrial Microbiology.** MacMillan India Ltd., Chennai.		
3	*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.		
2	*Hugo, W.B. and Russell, A.D.* 1998. **Pharmaceutical Microbiology.**[Sixth Edition]. Blackwell Scientific Company Ltd., USA.		

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Recall the basics and importance of industrially important microbes.
CO2	Apply the techniques for the formulation of media for microbial products.
CO3	Develop the suitable conditions for maximum product yield.
CO4	Apply fermentation technology for production of microbial products.
CO5	Demonstrate chemotherapeutic drugs production under *in vitro* conditions.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	L	L	H	H
CO2	L	L	L	H	H
CO3	L	M	M	H	H
CO4	L	M	M	H	H
CO5	H	H	H	H	H

H-High; M-Medium; L-Low

18PMBBTIP301	INTER DISCIPLINARY COURSE PRACTICAL II: INDUSTRIAL MICROBIOLOGY	SEMESTER – III

Course Objectives:

The Course aims

- To learn the basic techniques in industrial microbiology.
- To acquire knowledge on antibiotics and its susceptibility.

Credits: 2 **Total Hours:30**

Experiment	CONTENTS	Hrs	CO
1.	Screening of antibiotic producing organisms from soil.	**03**	**CO1**
2.	Screening of amylase enzyme producing organisms from soil.	**02**	**CO1**
3.	Antibiotic sensitivity disc preparation.	**05**	**CO1**
4.	MIC determination by filter paper disc assay.	**05**	**CO2**
5.	Antibiotic susceptibility method- Kirby Bauer method.	**05**	**CO2**
6.	Evaluation of disinfectant- Phenol Coefficient method.	**05**	**CO2**
7.	Wine production	**05**	**CO2**

Reference Books

1	*Gerald Collee, J. Barie P.Marmion, Andrew, G. Fraser and Anthony Simmons*. 1996. **Mackie and MacCartney Practical Medical Microbiology.** Fourteenth edition. Churchill Livingstone Publishers.
2	*Sundararaj, T.* **Microbiology Laboratory Manual.** Dr.A.L.Mudaliyar Post Graduate Institute of Basic Medical Sciences, Chennai.

COURSE OUTCOMES (CO)

After completion of the course, the students' will be able to

CO1	Assess antibiotic and enzyme production and produce industrially important products.
CO2	Evaluate the susceptibility of antibiotics and disinfectants.

18PBTM401	CORE XI: FOOD AND PHARMACEUTICAL BIOTECHNOLOGY	SEMESTER - IV

Course Objectives:

The Course aims

- To learn the basics about the food and food products.
- To study the basics about the pharmaceutical biotechnology.

Credits:5 **Total Hours:50**

UNIT	CONTENTS	Hrs	CO
I	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.	**10**	**CO1**
II	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.	**10**	**CO2**
III	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.	**10**	**CO3**
IV	History and scope of Pharmaceutical biotechnology, Production of antibiotics from the microbes- penicillin, streptomycin, Biomimicry and Bioprospecting, enzymes responsible for biotransformation.	**10**	**CO4**
V	Quality assurance and control – concept of good manufacturing practices, role of FSSAI and HACCP, test marketing and release into the market, Hormones. Quality	**10**	**CO5**

	assurance, Drug metabolism – biotransformation of drugs, 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.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Explain dietary sources and fermented food products.
CO2	Illustrate the production of beverages, food colorants as well as factors responsible for food spoilage.
CO3	Demonstrate the principles and methods of food preservation.
CO4	Know the production, manufacturing of antibiotics and drugs and tablet packaging.
CO5	Learn the role of FDA, drug metabolism and pharmacology.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H`	L	L	M
CO2	H	M	M	L	H
CO3	M	H	M	M	L
CO4	H	H	M	M	H
CO5	H	H	L	M	H

H-High; M-Medium; L-Low

18PBTEL401	ELECTIVE II: ENVIRONMENTAL BIOTECHNOLOGY	SEMESTER - IV

Course Objectives:

The Course aims

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

Credits: 4 **Total Hours:50**

UNIT	CONTENTS	Hrs	CO
I	EIA, 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.	**10**	**CO1**
II	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.	**10**	**CO2**
III	Introduction, constraints and priorities of Bioremediation, Biostimulation of Naturally occurring microbial activities, Bioaugmentation, *in situ, ex situ*, intrinsic & engineered bioremediation, Phytoremediation. Composting, Bioventing & Biosparging; Liquid phase bioremediation - Suspended bioreactors, Fixed biofilm reactors. Bioremediation of oil contaminated soil and water.	**10**	**CO3**

IV	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, Fuel cells, Alcohols and algal hydrocarbons,Use of microorganisms in augmentation of petroleum recovery. CO2 sequestration through plant.	**10**	**CO4**
V	Introduction - Xenobiotic compounds, Biodegradation of Xenobiotics. Biological detoxification- hazardous waste management, cyanide detoxification - detoxification of oxalate, urea and toxic organics like phenols. Polyhydroxy Butyrate, Natural Biopolymers.	**10**	**CO5**
Reference Books			
1	*Wesley, W. and Eckenfelder, J.R.* 2000. **Industrial Water Pollution Control**. [Third Edition]. Mc Grow – 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. **Microbial 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.		

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Solve the environmental issue through biotechnological approaches.
CO2	Treat the industrial waste water by biological treatment.
CO3	Apply bioremediation to the contaminated soil and water.
CO4	Use microbes to leach metals and to produce biogas.
CO5	Manage the hazardous waste and to detoxify them.

MAPPING

PSO / CO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	M	H	M	H	M
CO2	M	H	M	M	L
CO3	H	H	M	H	M
CO4	H	M	L	M	M
CO5	H	M	L	H	M

H-High; M-Medium; L-Low

18PBTEL402	ELECTIVE II: EVOLUTION AND BIODIVERSITY	SEMESTER - IV

Course Objectives:

The Course aims

- To understand the evolutionary concept and biodiversity.

Credits: 4 **Total Hours:50**

UNIT	CONTENTS	Hrs	CO
I	Lamarckism; Darwin–concepts of variation, adaptation, Speciation, struggle, fitness and natural selection. Major groups of plants and animals (Evolutionary tree).	**08**	**CO1**
II	Origin of cells and unicellular evolution: Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiment of Miller; The first cell; Evolution of prokaryotes; Origin and evolution of eukaryotic cells, Anaerobic metabolism, photosynthesis and aerobic metabolism.	**12**	**CO2**
III	Paleontology and Evolutionary History: The evolutionary time scale - Era, period and epoch; Major events in the evolutionary time scale; Stages in primate evolution including Homo.	**10**	**CO3**
IV	**Principles & methods of taxonomy:** Concepts of species and hierarchical taxa, biological nomenclature, classical & quantitative methods of taxonomy of plants, animals and microorganisms. **Levels of structural organization:** Unicellular, colonial and multicellular forms. Levels of organization of tissues, organs & systems.	**08**	**CO4**
V	Major habitat types of Indian subcontinent, Common	**12**	**CO5**

	Indian mammals, birds. **Organisms of conservation concern:** Rare, endangered threatened and endemic species. Red data Book, Conservation strategies. Biodiversity types, Loss of biodiversity, Climate change and its impacts, Kyoto protocol, Geneva convention, Indian Biodiversity Acts.		
Text Book			
1	Veer Bala Rastogi. 12th Edition. **Organic evolution**. Kedarnat Ramnath, Meerut, Delhi.		
2	Jha AP, 1997. **Genes and Evolution.** Mac Millan India Limited.		

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Explain about Lamarckism, Darwin concepts and evolutionary tree.
CO2	Attain knowledge about evolution, photosynthesis and metabolism.
CO3	Explain about Paleontology and Evolutionary History.
CO4	Describe about taxonomy.
CO5	Attain knowledge about Conservation strategies and Biodiversity.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	L	L	L	L
CO2	M	L	L	L	M
CO3	M	H	L	M	L
CO4	H	L	L	M	L
CO5	H	H	M	L	M

H-High; M-Medium; L-Low

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) THEORY

The candidate shall be declared to have passed the Examination, if the candidate secures 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)

II) PRACTICAL

The candidate shall be declared to have passed the Examination, if the candidate secures 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	: 5X3=15 Marks
Viva voce	: 05 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
Major experiment	: 25 Marks
Minor experiment	: 15 Marks
Spotters	: 5X3=15 Marks
Viva voce	: 05 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** : 5x3=15 Marks
4. **Viva – Voce** **:** 05 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 of the 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. Literature Collection	:	10 Marks
2. Attendance	:	10Marks
3. Observation Note	:	10 Marks
4. Review	:	20 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

3. CAREER COMPETENCY SKILLS- METHODOLOGY OF ASSESSMENT On Line Objective Examination (Multiple Choice questions)

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.

INTER DISCIPLINARY COURSE (IDC)

S.NO	SUBJECT CODE	SUBJECT	SEMESTER	OFFERED TO THE STUDENTS OF
1.	18PBTMBI201/ 18PBTBCI201	IDC I: Plant Tissue culture technology	II	Microbiology/ Biochemistry
2.	18PBTMBIP201/ 18PBTBCIP201	IDC Practical I: Plant Tissue culture technology	II	Microbiology/ Biochemistry
3.	18PBTMBI301/ 18PBTBCI301	IDC II: Animal cell culture technology	III	Microbiology/ Biochemistry
4.	18PBTMBIP301/ 18PBTBCIP301	IDC Practical II: Animal cell culture technology	III	Microbiology/ Biochemistry

18PBTMBI201/ 18PBTBCI201	**INTER DISCIPLINARY COURSE I: PLANT TISSUE CULTURE TECHNOLOGY**	**SEMESTER- II**

Course Objectives:

The Course aims

- To understand the basic techniques in plant tissue culture.

Credits:2 **Total Hours: 40**

UNIT	CONTENTS	Hrs	CO
I	Introduction to Plant cells, Types of plant cells, Principles of plant tissue culture, Tissue culture media, Growth regulators and Sterilization techniques.	**07**	**CO1**
II	Callus and suspension culture, Micropropagation, Meristem culture, Somatic embryogenesis, Protoplast isolation, Fusion of protoplast, Somaclonal variations.	**08**	**CO2**
III	*Agrobacterium mediated* gene transfer, *Agrobacterium* based vectors, direct gene transfer methods - electroporation, microinjection, particle bombardment.	**09**	**CO3**
IV	Genetic engineering for quality improvement-Protein, lipids, carbohydrates, and vitamins, Production of resistant plants - Herbicide resistance, Insect resistance (Bt approach), Abiotic stress tolerance plant production - Drought, temperature and salt.	**10**	**CO4**
V	Secondary metabolites from plants – Alkaloids, flavonoids and phenolic compounds, Germplasm conservation.	**06**	**CO5**

Text Book

1 *Bhojwani, S.S., and Razdan, M.K.* 2008. **Plant Tissue Culture – Theory and Practice.** Elsevier Publishers, New Delhi.

Reference Books	
1	*Chawla, H.S.* 1998. **Biotechnology in Crop Improvement.** International Book Distribution Co., New Delhi.
2	*Hopkins, W.G. and Hiiner, N.P.A.* 2004. **Introduction to Plant Physiology.** [Third Edition]. John Wiley and Sons, New Jersey, USA.
3	*Jain, V.K.* 2013. **Fundamentals of Plant Physiology**. [Fifth Edition]. S. Chand and Company, New York.
4	*Trivedi, P.C.* 2004. **Advances in Plant Physiology**. [Third Edition]. I.K. International Publications Pvt Ltd., New Delhi.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Simplify the types of plant cells and will able to utilize various sterilization techniques
CO2	Utilize the micro propagation and isolation of plant tissue
CO3	Analyze the techniques for Transfer gene by biological and physical method
CO4	Contrast the benefits and develop the genetically modified crops
CO5	Demonstrate the Extraction and identification of secondary metabolites

MAPPING

PSO / CO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	L	L	M	M	H
CO2	L	L	M	M	H
CO3	L	M	M	M	H
CO4	M	M	M	H	H
CO5	H	H	H	H	H

H-High; M-Medium; L-Low

18PBTMBIP201/ 18PBTBCIP201	INTER DISCIPLINARY COURSE PRACTICAL I:PLANT TISSUE CULTURE TECHNOLOGY	SEMESTER -II

Course Objectives:

The Course aims

- To get hands on experience on Plant tissue culture.

Credits: 2 **Total Hours: 24**

S.No	EXPERIMENT	Hrs	CO
1.	Media preparation	**06**	**CO1**
2.	Hormone stock solution preparation	**06**	
3.	Callus induction	**03**	
4.	Micropropagation	**03**	
5.	Protoplast isolation	**03**	
6.	Synthetic seed preparation	**03**	

Reference Book

1 *Aneja, K.R.* 2003. **Experiments in Microbiology, Plant pathology and Biotechnology.** [Fourth Edition]. New age international.

2 *Bhojwani, S.S. and Razdan, M.K.* 2008. **Plant Tissue Culture– Theory and Practice**. Elsevier Publishers, New Delhi.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Prepare media for plant tissue culture and cultivate the plant tissues/cells.

18PBTMBI301/ 18PBTBCI301	**INTERDISCIPLINARY COURSE II: ANIMAL CELL CULTURE TECHNOLOGY**	**SEMESTER - III**

Course Objectives:

The Course aims

- To understand the basic techniques in Animal cell culture.

Credits: 2 **Total Hours: 40**

UNIT	CONTENTS	Hrs	CO
I	Introduction to Animal cell culture, Applications of cell culture, Designing the cell culture laboratory –washing and sterilization area, Storage area and cell culture room, Equipments in tissue culture laboratory – Inverted Microscope, Centrifuge, Laminar flow benches, CO_2 incubator.	**08**	**CO1**
II	Glass ware and other plastic ware in tissue culture Substrate materials for growing cells, cell culture vessels, culture media – Properties and special requirements, Complete media, Conditioned media.	**08**	**CO2**
III	Type of cell culture - Isolation of primary explants culture, Isolation of cells and disaggregation method cell culture, organ culture.	**08**	**CO3**
IV	Cell culture-Transformation, Differentiation and Dedifferentiation, Growth curve of cells, Types of microbial contamination, Stem cell culture.	**08**	**CO4**
V	Applications of Animal cell culture technology–Somatic cell fusion, Transgenic fish and sheep.	**08**	**CO5**

Reference Books

1 *Sudha Gangal*, 2010. **Principles and Practice of Animal Tissue Culture**. [Second Edition]. University Press (India)Pvt. Ltd.

2 *Freshney, R.I.*2005.**Culture of Animal Cells: A manual of basic technique.** [Fifth Edition]. John Wiley and Sons, New Jersey.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Handle animal cells and familiar with instruments
CO2	Prepare animal tissue culture media for culturing animal cells
CO3	Disaggregate the animal tissues
CO4	Differentiate cells and stem cells
CO5	Apply the animal cell culture technology in day to day life

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	L	H	M
CO2	M	H	L	H	M
CO3	M	L	M	H	H
CO4	H	M	H	H	M
CO5	M	M	M	H	M

H-High; M-Medium; L-Low

18PBTMBIP301/ 18PBTBCIP301	INTER DISCIPLINARY COURSE PRACTICAL II: ANIMAL CELL CULTURE TECHNOLOGY	SEMESTER -III

Course objectives:

The Course aims

- To get hands on experience on Animal cell culture.

Credits:2 **Total Hours: 24**

S.No	EXPERIMENT	Hrs	CO
7.	Sterilization techniques in Animal cell culture	**06**	**CO1**
8.	Media preparation for Animal cell culture	**06**	
9.	Primary culture of Chick embryo fibroblast	**03**	**CO2**
10.	Trypsinization and subculturing	**06**	
11.	Determination of viability of cells using Trypan blue stain.	**03**	**CO3**

Reference Book

1 *Freshney, R.I.*2005. **Culture of Animal cells: A manual of basic technique**. [Fifth edition]. John Wiley and Sons, New Jersey.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Sterilize the media and utensils for Animal cell culture
CO2	Cultivate the animal cells and maintain it for further studies.
CO3	Analyse viable cells.