MASTER OF SCIENCE (APPLIED MICROBIOLOGY)

VISION

To produce intellectual mind and professionals through innovative research and inventions for the enhancement of society.

MISSION

- To establish overall competence among the students by inculcating energetic thinking and positive spirit.
- To cultivate knowledge, skills, values and confidence for the students excellence through research in their area of expertise or interest.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

PEO 1: To provide the students with subject proficiency, environmental awareness, ethical codes and guidelines, along with life education for a successful professional career.

PEO2: To inculcate the student's professional competencies and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and related to life science.

PEO3: To train students with good technical skills in research to comprehend, analyze, design, novel products and to give solutions for the real life problems.

PROGRAMME OUTCOMES (PO)

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

PO1: Acquire and apply specialized skills and knowledge relevant to the needs of the society.

PO2: Develop the skills in handling instruments, planning and performing experiments to meet desired needs within realistic constraints through domain knowledge.

PO3: Expand a modern and scientific outlook with respect to science subjects and apply in all aspects of life.

PO4: Apply modern tools and technologies for sustainable development and welfare of the society.

PO5: Create and develop eco-friendly environment and microbial products through innovative research ideas.

PROGRAMME SPECIFIC OUTCOMES (PSO)

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

PSO1: Recall the fundamentals of microbiology which would enable them to comprehend the emerging and advanced scientific concepts in life sciences.

PSO2: Apply the acquired conceptual knowledge by connecting interdisciplinary aspects of microbiology.

PSO3: Evaluate the need and impact of scientific solutions on the environment for the betterment of society.

PSO4: Analyze the technical knowledge in microbiology for research and lifelong learning.

PSO5: Create and develop the employable, entrepreneur and socially responsible citizens.

MASTER OF SCIENCE (APPLIED MICROBIOLOGY)
REGULATIONS

ELIGIBILITY

Candidate who has passed the B.Sc., degree in any Life sciences (Microbiology/ Applied Microbiology / Industrial Microbiology/ Botany / Plant Sciences and Plant Biotechnology/ Zoology /Animal Science/Applied Animal Science and Animal Biotechnology/Biochemistry /Bioinformatics /Biology /Life Sciences/ Home Science/ Food Science & Nutrition/ BSMS/ BAMS/ BUMS/ Chemistry with Botany/ Zoology as Allied Subjects of this University or any Examination of any other University accepted by the Syndicate as equivalent thereto shall be eligible for admission to M.Sc. Degree Course in Microbiology.

Candidate shall be admitted to the examination only if he / she has taken the qualifying degree in Science / Medical subjects as mentioned after having completed the prescribed courses consisting of twelve years of study and has passed the qualifying examination.

DURATION OF PROGRAMME

M.Sc., Applied Microbiology is a two years program which comprised of four semesters.

MAXIMUM DURATION FOR THE COMPLETION OF THE PG PROGRAMME

The maximum duration for completion of the PG Programme shall not exceed 8 semesters.

SCHEME OF EXAMINATION

Subject Code	Subject	Hours of Instruction	Exam Duration	Maximum Marks			Credit Points
				CA	CE	Total	
FIRST SEMESTER							
Part A							
18PMBM101	Core I: Fundamentals of Microbiology and Taxonomy	5	3	25	75	100	5
18PMBM102	Core II: Microbial Biochemistry and Physiology	5	3	25	75	100	5
18PMBM103	Core III: Microbial Genetics	5	3	25	75	100	5
18PMBM104	Core IV: Immunology	5	3	25	75	100	5
18PMBM105	Core V: Bioinstrumentation	4	3	25	75	100	4
18PMBMP101	Core Practical I: Fundamentals of Microbiology & Taxonomy, Microbial Biochemistry & Physiology, Microbial Genetics, Immunology & Bioinstrumentation	5	9	40	60	100	4
Non Credit							
18PLS101	Career Competency Skills I	1	-	-	-	-	-
	Total	**30**				**600**	**28**
SECOND SEMESTER							
Part A							
18PMBM201	Core VI: Soil and Agricultural Microbiology	5	3	25	75	100	5
18PMBM202	Core VII: Medical Microbiology	5	3	25	75	100	5
18PMBEL201	Elective I	5	3	25	75	100	4
18PMBMP201	Core Practical II: Soil and Agricultural Microbiology, Medical Microbiology, Environmental	6	9	40	60	100	4

	Microbiology and Cell biology						
Optional Subjects							
18PBCMBI201	IDC I: Diagnostic Biochemistry	3	3	25	75	100	2
18PBCMBIP201	IDC Practical I: Diagnostic Biochemistry	3	3	40	60	100	2
18PBTMBI201	IDC I: Plant Tissue Culture Technology	3	3	25	75	100	2
18PBTMBIP201	IDC Practical I: Plant Tissue Culture Technology	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**	**24**
THIRD SEMESTER							
Part A							
18PMBM301	Core VIII: Genetic Engineering	6	3	25	75	100	5
18PMBM302	Core IX: Biostatistics and Research Methodology	5	3	25	75	100	4
18PMBEL301	Elective II	5	3	25	75	100	5
18PMBMP301	Core Practical III: Genetic Engineering, Industrial Microbiology, and Food and Dairy Microbiology	6	9	40	60	100	3
18PMBMP302	Core Practical IV: Statistical Software	2	3	40	60	100	2
Optional Subjects							
18PBCMBI301	IDC II: Pharmaceutical Biochemistry	3	3	25	75	100	2
18PBCMBIP301	IDC Practical II: Pharmaceutical	3	3	40	60	100	2

	Biochemistry						
18PBTMBI301	IDC II: Animal Tissue Culture Technology	3	3	25	75	100	2
18PBTMBIP301	IDC Practical II: : Animal Tissue Culture Technology	3	3	40	60	100	2
Part B							
	Total	**30**				**700**	**23**
FOURTH SEMESTER							
Part A							
18PMBM401	Core X: Industrial Microbiology	5	3	25	75	100	4
18PMBM402	Core XI: Food and Dairy Microbiology	5	3	25	75	100	5
18PMBPR401	Project and Viva Voce	5	-	50	150	200	6
Total		**15**				**400**	**15**
Grand Total						**2400**	**90**

ELECTIVE

The students shall choose any one of the following subjects as Elective I and II in the Second and Third semesters respectively.

Elective I

S.No.	SEMESTER	SUBJECT CODE	SUBJECT
1.	II	18PMBEL201	Elective I: Environmental Microbiology
		18PMBEL202	Elective I: Cell Biology

Elective II

S.No.	SEMESTER	SUBJECT CODE	SUBJECT
1.	III	18PMBEL301	Elective II: Bioinformatics, Bioethics and IPR
		18PMBEL302	Elective II: Pharmaceutical Microbiology

FOR COURSE COMPLETION

- Student shall complete:
- Value Education: Human Rights in II semester.
- IDC in II and III semester.
- Elective subjects in II and III semesters.
- Project & Viva-Voce in IV semester.
- Career Competency Skills in I and II semester.

TOTAL MARKS AND CREDIT DISTRIBUTION

S.No.	COMPONENT	MARK	CREDITS
1.	PART A: Core, Elective and IDC subjects	2300	88
2.	PART B: Value Education	100	02
TOTAL		**2400**	**90**

18PMBM101	CORE I : FUNDAMENTALS OF MICROBIOLOGY AND TAXONOMY	SEMESTER I

Course Objectives:

The course aims

- To recall the basics of Microbiology.
- To acquire the knowledge about microbial media and sterilization.
- To study the cell structure, microbial nutrition and growth.

Credits: 05 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Spontaneous generation theory**: Contribution to microbiology by Antony Van Leeuwenhoek, Louis Pasteur, Robert Koch, Alexander Fleming, Joseph Lister and Edward Jenner. Prokaryotic cell structure: cell membrane – Archeal membrane, cytoplasmic matrix – inclusion bodies – ribosomes. Nucleoids and plasmids. Components externals to cell wall (capsule, slime layers and S layers). Pili and fimbriae- Flagella- Chemotaxis. Bacterial endospores.	**10**	**CO1**
II	**Microbial structure**: Bright field microscope – resolution, numerical aperture. Types of microscopy - Dark field microscope, Phase contrast microscope, Fluorescent microscope. Electron microscope – Scanning Electron Microscope and Transmission electron microscope - Confocal Microscope. Stains – simple, differential and special staining.	**10**	**CO2**
III	**Microbial nutrition**: Nutritional requirements, nutritional types of microorganisms. Uptake of nutrients – passive diffusion, facilitated diffusion, active transport, group translocation and ion uptake. Types of media - simple media, complex media, selective media, enriched media,	**10**	**CO3**

	differential media. Pure cultures techniques – spread plate, streak plate and pour plate.		
IV	**Microbial evolution**: Classical classification – Haeckel's three kingdom concepts – Whittaker's five kingdom concepts. Taxonomy hierarchy - binomial nomenclature. Classical systems of classification – dichotomy, chemotaxonomy and numerical taxonomy.	**10**	**CO4**
V	**Molecular based classification:** DNA - DNA hybridization - protein sequencing – rRNA sequencing. Classification and salient features of bacteria according to the Bergey's manual of determinative bacteriology.	**10**	**CO5**
Text Books:			
1.	*Prescott, L.M., Harley, J. P and Klein, D.A.* 2012. **Microbiology.** [Eighth Edition]. WMC. Brown Publishers.		
2.	*Atlas, R.M.* 1997. **Principles of Microbiology.** [Second Edition]. WCK. Mc Graw– Hill.		
Reference Books:			
1.	*Robert F Boyd.* 1984. **General Microbiology**. Times Mirror/Mosby College Publishers, Boston.		
2.	*Edward Alcamo.* 2001. **Fundamentals of Microbiology**. [Sixth Edition]. Jones and Bartlett Publishers, New York.		
3.	*Black, J.G.* 1999. **Microbiology-Principles and Exploration.** [Fourth Edition]. Prentice Hall International Inc.		

COURSE OUTCOMES (CO)

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

CO1	Recall the scope and concepts of Microbiology.
CO2	Apply the microscopic and staining techniques for visualization of bacteria in the laboratory.
CO3	Formulate media and apply various parameters for microbial growth.
CO4	Apply aseptic condition for maintenance of pure culture and control of contaminants.
CO5	Assess the use of antibiotics to control pathogens and treatment of microbial diseases.

MAPPING

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

H-High; M-Medium; L-Low

18PMBM102	CORE II: MICROBIAL BIOCHEMISTRY AND PHYSIOLOGY	SEMESTER I

Course Objectives:

The course aims

- To formulate the students aware about the role of biochemistry in microbial metabolism.
- To illustrate the various pathways involved in microbial metabolism.

Credits: 05 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Enzyme and enzyme kinetics:** Introduction, classification, properties and specificity of enzyme, recognition of enzymes-inhibiting agent. Coenzyme, lysozyme, isozyme, kinetic theory of reaction- control of enzyme synthesis- mechanism of enzyme action. Location of enzymes in the cell.	**10**	**CO1**
II	**Biomolecules:** Classification and structure of carbohydrates, Protein and Lipids.	**10**	**CO2**
III	**Microbial growth:** Prokaryotic cell cycle (binary fusion). Growth curve– different phases of growth– kinetics of growth. Measurement of microbial growth– cell number, membrane filtration procedure and cell mass. Continuous culture– chemostat and turbidostat; Synchronous culture. Various factors on growth – physical and chemical.	**10**	**CO3**
IV	**Microbial metabolism:** Anabolism– photosynthesis– oxygenic and anoxygenic. Catabolic metabolism– The Embden-Meyerhof- Parnas pathway, The Enter- Doudoroff, Citric acid cycle, Electron transport chain. Anaerobic respiration and fermentation – lactic acid, propionic acid and alcohol.	**10**	**CO4**
V	**Protein and lipid metabolism:** protein metabolism- lysine pathway, serine pahway and arginine pathway. Integration of	**10**	**CO5**

	metabolic pathway. ß oxidation of lipids.		
Text Books:			
1.	*Deb, A.C.* 2006. **Fundamentals of Biochemistry.** New Central Book Agencies Pvt. Ltd., Kolkatta.		
2.	*Salle, A.J.* 2001. **Fundamental Principles of Bacteriology**. [Seventh Edition]. Tata Mc Graw-Hill, New Delhi.		
Reference Books:			
1.	*Albert L. Lehninger., Michael M. Cox and David L. Nelson.* 2008. **Principles of Biochemistry**. [Fifth edition]. W H Freeman & Co., New York.		
2.	*Edward Alcamo.* 2001. **Fundamentals of Microbiology**. [Sixth Edition]. Jones & Bartlett Publishers, New York.		
3.	*Hans G Schlegel.* 2003. **General Microbiology**. [Seventh Edition]. Cambridge University Press, UK.		

COURSE OUTCOMES (CO)

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

CO1	Assess the role of mechanism and function of enzymes.
CO2	Discuss the structure and importance of biomolecules.
CO3	Apply the various parameters for microbial growth.
CO4	Design the important strategies for fermentation.
CO5	Evaluate the metabolism and biological role of lipids.

MAPPING

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

18PMBM103	CORE III: MICROBIAL GENETICS	SEMESTER I

Course Objectives:

The course aims

- To enable the students to understand the genetic organization of microbes.
- To impart the significant processes involving in microbial genetics.

Credits: 05 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Organization of prokaryotic and eukaryotic genome:** Nucleic acids- Structure of DNA, types of DNA, Chargaff rule and types of RNA. Transfer of genetic materials in prokaryotes: Transformation- competence and mechanism. Conjugation- the classical bacterial conjugation experiment - types of conjugation - conjugation in mapping the bacterial genome. Transduction – generalized and specialized transduction.	**10**	**CO1**
II	**DNA replication:** Semi-conservative mode of DNA replication- enzymology of DNA replication- Messelson and Stahl experiment- rolling circle replication- bidirectional replication. Transcription (Prokaryotes) - the basic mechanism of transcription- process of transcription- initiation- elongation and termination- Inhibitors of transcription- Post transcriptional modification of m-RNA- temporal control of transcription.	**10**	**CO2**
III	**Translation, expression and regulation:** Translation- the genetic code-mechanism of translation- initiation-elongaton-termination- inhibitors of translation. Post translational modifications. Gene regulation- General aspects of prokaryotic gene regulation –Operon concept- the *lac, trp, ara* and *Gal* operon. Eukaryotic gene regulation- regulatory	**10**	**CO3**

	strategies in Eukaryotes - gene alteration - regulation of synthesis of primary transcripts.		
IV	**Mutation**: Types - somatic versus germ line mutation, morphological mutation, nutritional mutation, lethal mutations and conditional mutations. Molecular basis of mutation - Missense and nonsense mutations, spontaneous mutations, chemical mutagenesis, radiation - induced mutations, silent mutations and reversions. Detection of mutants- replica plate and gradient plate method. Carcinogenicity test. DNA repair – Biological indication of repair - biochemical mechanisms for repair of thymine dimers- light and dark repair.	**10**	**CO4**
V	**Recombination and plasmids**: General properties - types of plasmids and its derivatives. Transposable elements – definition - types of bacterial transposons - mechanism of transposition. Bacterial Artificial Chromosome and Yeast Artificial Chromosome. Genetic recombination- mechanism of general recombination -Holliday model, site specific recombination.	**10**	**CO5**
Text Books:			
1.	*Deb, A.C.* 2006. **Fundamentals of Biochemistry.** New Central Book Agencies Pvt. Ltd., Kolkatta.		
2.	*Salle, A.J.* 2001. **Fundamental Principles of Bacteriology**. [Seventh Edition]. Tata Mc Graw-Hill, New Delhi.		

Reference Books:	
1.	*Albert L. Lehninger., Michael M. Cox and David L. Nelson.* 2008. **Principles of Biochemistry**. [Fifth edition]. W H Freeman & Co., New York.
2.	*Edward Alcamo.* 2001. **Fundamentals of Microbiology**. [Sixth Edition]. Jones & Bartlett Publishers, New York.
3.	*Hans G Schlegel.* 2003. **General Microbiology**. [Seventh Edition]. Cambridge University Press, UK.

COURSE OUTCOMES (CO)

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

CO1	Recall the basics about prokaryotic and eukaryotic genome and DNA repair mechanisms.
CO2	Apply the genomic knowledge for the production of novel proteins.
CO3	Evaluate the regulation system of gene for various industrial products.
CO4	Explain about mutation and its types and apply for its detection.
CO5	Assess gene transfer mechanisms for production of novel products.

MAPPING

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

H-High; M-Medium; L-Low

18PMBM104	CORE IV: IMMUNOLOGY	SEMESTER I

Course Objectives:

The course aims

- To learn functions of immune system and their immune complexes.
- To understand the mechanisms of immune response and autoimmune disorders.

Credits: 05 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Historical perspective of Immunology:** Hematopoiesis – process and regulation, stromal cells, programmed cell death. Cells of the immune system – Organs of the immune system – primary and secondary lymphoid organs. Early theories and clonal selection theory. Innate immunity, acquired Immunity, humoral and cell mediated immunity.	**10**	**CO1**
II	**Antigens:** Factors influencing immunogenicity – epitopes, haptens and adjuvants. Immunoglobulins – basic structure and classes – Diversity. Monoclonal antibodies – production, formation and clinical uses. Antigen – Antibody reactions – agglutination, precipitation, complement fixation, immunofluorescence, ELISA and Radio Immunoassay.	**10**	**CO2**
III	**Antigen processing and Histocompatability complex:** Antigen processing cells, Processing of exogenous and endogenous antigens. Major Histocompatibility complex – structure and functions - Class I, Class II and Class III molecules. T – Cell receptor – structure, organization and maturation. Cytokines – Structure and functions.	**10**	**CO3**
IV	**Complement activation:** Classical, alternative and terminal complement pathways. Hypersensitive reactions – classification – IgE mediated (Type –I), antibody mediated	**10**	**CO4**

	cytotoxic (Type –II), immune complex mediated (Type III), TDTH - mediated (Type IV). Vaccines – active and passive immunization, Types of Vaccines – polysaccharide, toxoid and recombinant vaccines.		
V	**Autoimmunity:** Organ specific autoimmune diseases – diseases mediated by direct cellular damage and stimulating or blocking antibodies- Hashimotus Thyrioditis, autoimmune anemia's, Grave's Disease, Myasthenia Gravis. Systemic autoimmune disease – Systemic lupus erythematosus. Transplantation immunology – Graft versus host reactions – Tumor immunology.	**10**	**CO5**
Text Books:			
1.	*Richard A Goldsby, Thomas J. Kindt, Barbara A Osborn and Janis Kuby.* 2003. **Immunology.** [Fifth Edition]. W. H. Freeman and Company, New York.		
2.	*Tizard, K.* 2004. **Immunology – An Introduction**. Saunders College, Philadelphia.		
Reference Books:			
1.	*Ivan Roitt, Jonathan Brostolf and David Male.* 2004. **Immunology.** [Sixth Edition]. Mosby Publications, Edinburg.		
2.	*Abul Abbas.* 2011. **Cell and Molecular Immunology.** [Seventh Edition]. Saunders, USA.		

COURSE OUTCOMES (CO)

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

CO1	Recall the basics concepts of immunology.
CO2	Analyze the knowledge of proteins for the detection and prevention of diseases.
CO3	Evaluate the regulatory mechanism of the body against foreign antigens.
CO4	Apply knowledge of immune system for vaccine production.
CO5	Formulate and develop anti-hypersensitivity drugs.

MAPPING

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

H-High; M-Medium; L-Low

18PMBM105	CORE V: BIOINSTRUMENTATION	SEMESTER I

Course Objectives:

The course aims

- To expose the students to the basic principles, working mechanism and applications of various analytical instruments.
- To foster the needs of the present day students to meet out the requirements of analytical techniques in biology.

Credits: 04 **Total Hours: 40**

UNIT	CONTENTS	Hrs	CO
I	**Centrifugation:** Principles of sedimentation, centrifugal force, Swedberg constant. Types of centrifuges – Desk top, High speed and Ultra Centrifuge. Centrifugation - methods and its applications – Differential, Density gradient.	08	CO1
II	**Chromatography:** Fundamental concepts – Stationary Phase, Mobile Phase, Elution, Retention. Working Principle and applications of Paper, Thin layer, column, Ion exchange, Affinity chromatography, GC – MS, HPLC, LC – MS.	08	CO2
III	**Electrophoresis:** Basic principles, Factors affecting electrophoretic mobility, Types of electrophoresis –Paper electrophoresis, Agarose gel electrophoresis, Sodium Dodecyl Sulphate - Poly Acrylamide Gel Electrophoresis, Two Dimensional and Immuno electrophoresis, Capillary electrophoresis.	08	CO3
IV	**Spectroscopy:** Basic Principles – Beer Lambert's law. Instrumentation, working mechanism and applications of Colorimeter, UV-VIS Spectrophotometer, Atomic Absorption Spectrophotometer, Nuclear Magnetic Resonance Spectrophotometer, XRD; Mass spectrophotometry -	08	CO4

	principle and applications. MALDI-TOF.		
V	**Radioisotopes and Physicochemical Techniques:** Radioactivity – Measurement - GM Counter, Autoradiography and Liquid Scintillation Counter. FTIR.	**08**	**CO5**
Text Books:			
1.	*Upadhyay, A. and Upadhyay, K.* 1998. **Biophysical Chemistry – Principles and Techniques.** [Third Edition]. Himalaya Publishing House, Mumbai.		
2.	*Wilson, K. and Walker, J.* 2003. **Practical Biochemistry - Principles and Techniques.** [Sixth Edition]. Cambridge University Press, Cambridge, UK.		
Reference Books:			
1.	*Palanivelu, P.* 2001. **Analytical Biochemistry and Separation Techniques – A Laboratory Manual.** [Second Edition]. Tulsi Book Centre, Madurai.		
2.	*Asokan, P.* 2001. **Analytical Biochemistry (Biochemical Techniques).** [First Edition]. Chinnaa Publications, Vellore.		
3.	*Vogel, A.I, Tatchell, A.R., Furnis, B.S., Hannaford, A.J. and Smith, P.W.G.* 1989. **Vogel's Textbook of Practical Organic Chemistry**. [Fifth Edition]. Longman Publications, UK		
4.	*Skoog, D.A. 2006.* **Principles of Instrumental Analysis**. [Sixth Edition]. Thompson Brooks/Cole: Belmont, CA.		

COURSE OUTCOMES (CO)

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

CO1	Analyze the separation methods of biomolecules based on hydrodynamic characters.
CO2	Evaluate the biomolecules from known standards.
CO3	Demonstrate the characteristics of biomolecules based on charges.
CO4	Assess the biomolecules based on spectral purity.
CO5	Predict biomolecules using radioisotopes.

MAPPING

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

H-High; M-Medium; L-Low

18PMBMP101	**CORE PRACTICAL I (Fundamentals of Microbiology and Taxonomy, Microbial Biochemistry and Physiology, Microbial Genetics, Immunology & Bioinstrumentation)**	**SEMESTER I**

Course Objectives

The course aims

- To learn the basic techniques of microbiology.
- To understand the morphological structures of bacteria.
- To cultivate and maintain the microorganisms.

Credit: 04 **Total Hours: 60**

Experiment	CONTENTS	Hrs	CO
1.	Measurement of bacterial cell size – Micrometry	**3**	**CO1**
2.	Pure culture techniques	**2**	**CO2**
3.	Motility – Hanging drop technique - Soft agar deeps	**5**	**CO1**
4.	Measurement of bacterial growth – Growth curve	**5**	**CO4**
5.	Simple staining	**3**	**CO1**
6.	Capsular staining	**3**	**CO1**
7.	Gram staining	**3**	**CO1**
8.	Endospore staining	**3**	**CO1**
9.	Acid-fast staining	**3**	**CO1**
10.	The effect of temperature on growth	**5**	**CO4**
11.	IMViC tests	**3**	**CO3**
12.	Carbohydrate fermentation	**5**	**CO3**
13.	Triple sugar iron (TSI) agar test.	**5**	**CO3**
14.	ABO Blood grouping – Rh typing and cross matching	**3**	**CO5**
15.	Agglutination tests – WIDAL, RA, ASO and CRP	**3**	**CO5**

16.	ODD and CIE	**3**	**CO5**
17.	ELISA – tridot (demo)	**3**	**CO5**
Reference Books:			
1.	*James G. Cappucino and Sherman Natalie* 2005. **Microbiology – A Laboratory Manual**. [Seventh edition]. Pearson education India, New Delhi.		

COURSE OUTCOMES (CO)

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

CO1	Identify and measure the size of the microbes through staining and micrometry with microscopy
CO2	Evaluate the isolation and purification of microorganisms.
CO3	Analyze the characteristics of microorganisms based on standard biochemical techniques.
CO4	Assess the bacterial growth and analyze its growth by physical environments.
CO5	Apply serological analysis for the detection of various infections.

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	3	CO1
II	Problems on Numbers –Problems on Ages	3	CO2
III	Calendar – Clocks – Pipes and Cisterns	3	CO3
IV	Time and Work – Time and Distance	3	CO4
V	Ratio and Proportion – Partnership – Chain Rule	3	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.

18PMBM201	CORE VI: SOIL AND AGRICULTURAL MICROBIOLOGY	SEMESTER II

Course Objectives:

The course aims

- To understand the types and role of soil microorganisms.
- To ascertain the importance and application of bio-fertilizers and biocontrol agents.

Credits: 05 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Soil Profile:** Properties of soil, structure, texture and formation of soil. Soil profile types. Classification of soil. Microbial grouping- Autochthonous, zymogenous population. Role of microbes in soil fertility, influence of soil environmental factors on microflora. Significance of soil microbes Bacteria, Archaea, eukaryotic algae and cyanobacteria, fungi, Actinomycetes, protozoa, Nematode and viruses.	**10**	**CO1**
II	**Biogeochemical cycle:** Carbon cycle, degradation of polysaccharides, phosphorous cycle, Nitrogen cycle. Biological nitrogen fixation- Symbiotic Nitrogen fixers, Root nodule formation. Non symbiotic bacteria – cyanobacteria. Biochemistry of nitrogen fixation- Nitrogenase, enzyme complex - associative dinitrogen fixation-process physiology and genetics of dinitrogen fixation.	**10**	**CO2**
III	**Biofertilizers:** Mass multiplication, field application and crop response *to Rhizobium, Azotobacter, Azospirullum, Phosphobacteria, Cyanobacteria, Azolla* and *Mycorrhizae.*	**10**	**CO3**
IV	**Plant pathology:** Introduction, Symptoms, disease cycle and	**10**	**CO4**

	control measures. Bacterial diseases- Blight of rice, Citrus canker. Mycoplasama disease- little leaf of brinjal, TMV. Fungal disease- Blast of rice, Light blight of potato, Rust of wheat, Red rot of sugarcane, Brown spot of rice, Wilt of cotton and Tikka leaf spot of groundnut.		
V	**Biopesticide and biocontrol agents:** Mode of action, formulation and application methods of Bacteria - *Bacillus thuringenesis;* Fungal- *Breuvaria bassiana* and viral- Nuclear polyhedrosis and *Baculovirus. Trichoderma viridae* and *Pseudomonas fluorescens*.	**10**	**CO5**
Text Books:			
1.	*Atlas, R.M. and Bartha, R*. 1992. **Microbial Ecology – Fundamentals and Applications.** [Fourth Edition]. Red Wood City C.A Benjamin/Cummings. Menlo Park, California, USA.		
2.	*Martin Alexander.* 1997. **Introduction to Soil Microbiology**. John Wiley & Sons, New York, USA.		
3.	*Rangaswami. G. and A. Mahadvan.* 1999. **Diseases of crop plants in India.** Fourth edition. Prentice Hall of India Pvt Ltd., New Delhi.		
4.	*Subba Rao, N.S. 1982.* **Advances in Agricultural Microbiology**. *Oxford and LBH publishing co.*		
5.	*Alexander N. Glazer and Hiroshi Nikaido.* **Microbiol biotechnology-Fundamentals of Applied Microbiology.** *W.H. Freeman and Co, New york.*		

Reference Books:	
1.	*Subbha Rao, M.S.* 1995. **Soil Microorganisms and Plant Growth**. Oxford and IBH. New Delhi.
2.	*Paul, E.A.* 2007. **Soil Microbiology and Biochemistry.** [Third Edition]. Academic Press - An imprint of Elsevier, Burlington, USA.
3.	*Bawden. F.C.* 1999. **Plant Diseases**. Greenworld. First Edition in India. Efficient offset printers. New Delhi.
4.	*Atlas, A.M. and R. Bartha*. 1998. **Microbial Ecology. Fundamentals and Applications**. An imprint of Addison Wesley longmann Inc.
5.	*Mark S. Coney*., 1999. **Soil Microbiology:** An exploratory approach., Delmar publishers, Singapore.

COURSE OUTCOMES (CO)

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

CO1	Analyze the soil-microbe interaction and understand the factors influencing the interaction.
CO2	Prepare effective biofertilizers for improving soil health.
CO3	Demonstrate the techniques for mass production of biofertilizers.
CO4	Assess the disease diagnosis of the plants from phytopathogens.
CO5	Create awareness for plant protection using biocontrol agents.

MAPPING

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

H-High; M-Medium; L-Low

18PMBM202	**CORE VII: MEDICAL MICROBIOLOGY**	**SEMESTER II**

Course Objectives:

The course aims

- To understand the basic principles and the etiological agents responsible for the infectious diseases.
- To foster a student's ability to understand the infections, immune response and pathogenic mechanisms.

Credits: 05 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	Morphology, cultural characteristics, pathogenesis, laboratory diagnosis, control: *Staphylococcus aureus, Streptococcus pneumoniae, Neisseria gonorrhoea, Corynebacterium diphtheriae, Mycobacterium tuberculosis, Clostridium tetani* and *Bacillus anthracis.*	**10**	**CO1**
II	Morphology, cultural characteristics, pathogenesis, laboratory diagnosis, control: *Escherichia coli, Klebsiella* sp., *Proteus* sp., *Salmonella* sp., *Shigella* sp., *Vibrio cholerae, Pseudomonas aeruginosa, Haemophilus influenza*, *Listeria monocytogenes, Rickettsia* and *Chlamydiae trachomatis.*	**10**	**CO2**
III	Superficial mycosis -Tinea, Piedra. Cutaneous mycosis - Dermatophytoses, Systemic mycosis - Blastomycosis and Histoplasmosis. Subcutaneous mycosis -Sporotrichosis, Opportunistic mycosis – *Candida, Cryptococcus* and *Aspergillus*. Antifungal agents.	**10**	**CO3**
IV	Introduction to Medical Virology – Morphology, pathogenesis, clinical manifestation and diagnosis of viruses: Ebola, Influenza, Hepatitis A and B, Rabies, Human Papiloma Virus, Herpes virus and HIV.	**10**	**CO4**
V	Introduction to Medical Parasitology - Morphology, life	**10**	**CO5**

	cycle, pathogenesis, clinical manifestation and diagnosis of parasites: *Ancyclostoma duodenale, Ascaris lumbricoides, Entamoeba histolytica, Giardia lamblia, Plasomodium vivax, Taenia solium* and *Wuchereria bancrofti.*		
Text Book:			
1.	*Ananthanarayan, R. and Jayaram Panicker, C.K.* 2005. **Text Book of Microbiology.** [Seventh Edition]. Orient Longman Pvt. Ltd., Chennai.		
2.	*Murray, M.R, Rosenthal, K.S, and Michael A Pfaller*. 2005. **Medical Microbiology.** Elsevier, Pennsylvania, USA.		
3.	*Subhash Chandra Parija*, 2004. **Text book of Medical Parasitology** – Protozoology and Helminthology. 2nd edition, All India Publishers and Distributors, Medical book publisher, New Delhi.		
4.	*Jegadish Chander*, 1996. **A Text Book of Medical Mycology**. Interprint, New Delhi.		
Reference Books:			
1.	*David Greenwood, Richard C.B. Slalk and John F. Peutherer.* 1998. **Medical Microbiology**. [Fifth Edition]. Churchill Livingston, New York.		
2.	*Slimeld, L.A., and Rodgers, A.T.* 1999. **Essentials of Diagnostic Microbiology**. Delmar Publications, USA.		
3.	*Dimmock, K.J. and Primrose, S.B.* 1994. **Introduction to Modern Virology**. [Fourth Edition]. Blackwell Science Ltd., UK.		
4.	*Lewy, J.A., H.C Fraenled and R.A. Owens.* 1994. **Virology.** [Third Edition]. Prentice Hall, New Jersey, USA.		
5.	*Rajesh Karyakarte and Ajith Damle.* 2005. **Medical Parasitology**, Books and Allied (P) Ltd.		
6.	*Chakraborthy, P.* 1995. **A Textbook Microbiology**, New Central Book Agency Pvt. Ltd., Calcutta.		

COURSE OUTCOMES (CO)

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

CO1	Analyze and diagnose the infections caused by Gram positive pathogens
CO2	Analyze and diagnose the infections caused by Gram negative pathogens
CO3	Create awareness against mycosis.
CO4	Evaluate the prognosis of dreadful viral diseases
CO5	Create awareness for parasitical infestation

MAPPING

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

H-High; M-Medium; L-Low

18PMBMEL201	**ELECTIVE I: ENVIRONMENTAL MICROBIOLOGY**	**SEMESTER II**

Course Objectives:

The course aims

- To impart the significant processes involving in environmental microbiology.
- To understand bioremediation process and biofuel production.

Credits: 04 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	Ecological Principles- ecosystem-types of ecosystems-dynamics of ecosystem- culturable and non-culturable bacteria- conventional and molecular methods of studying microbial diversity.	**10**	**CO1**
II	Aero-microbiology – Aerosol- droplet nuclei – Enumeration of bacteria from air – Air sampling devices – Air sanitation-Air borne diseases and their control measures. Aquatic Microbiology – Potability of water quality – Indicator organisms – MPN index – eutrophication - waterborne diseases and their control measures.	**10**	**CO2**
III	Sewage Microbiology – chemical and biochemical characteristics of sewage – Biological oxygen demand-Chemical oxygen demand – Sewage treatment – Physical, chemical and biological (trickling filter, activated sludge and oxidation pond) treatment – waste disposal.	**10**	**CO3**
IV	Role of microbes in environment – Bioremediation-bioremediation-types and its applications- bioremediation of hazardous waste and metals--biodegradation of paper, oil	**10**	**CO4**

	and pesticide–bio-deterioration of leather and textiles - Bioleaching of ores- phytoremediation.		
V	Microbial conversion of solid waste to food- mushroom-SCP— Bio-fuel - biofuel production– bioethanol, biogas, hydrogen and algal fuel - concepts of sustainable energy development. Microbial composting.	**10**	**CO5**
Text Books:			
1.	*Atlas, R.M and Bartha R*. 1980. **Microbial Ecology: Fundamentals and applications**. Fourth Edition, An imprint of Adiision Wesley Longman Inc.		
2.	*Vijaya Ramesh, K* (2004). **Environmental Microbiology**. 1st Edition, MJP Publishers (A unit of Tamil Nadu Book house), Chennai.		
Reference Books:			
1.	*Mithell R*. 1974. **Introduction to Environmental Microbiology**. Prantice Hall. Inc., Englewood Cliffs, New Jersey.		
2.	*Daniel J. C.* 1999**. Environment Aspects of Microbiology**. 1st Edition, Bright sun Publications, Chennai.		
3.	*Raina, M. M, Ian L. P and Charles P G*. 2000. **Environmental Microbiology.** Academic Press, USA.		

COURSE OUTCOMES (CO)

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

CO1	Recall the existence of living organisms and communities
CO2	Evaluate air quality, air sanitation and control air borne diseases.
CO3	Create awareness about proper disposal and recycling of waste water.
CO4	Develop remediation for control environmental pollution using microorganisms.
CO5	Assess commercial application of microbial products.

MAPPING

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

H-High; M-Medium; L-Low

18PMBMEL202	**ELECTIVE I: CELL BIOLOGY**	**SEMESTER II**

Course Objectives:

The course aims

- To ascertain the cellular level organization and its functions
- To understand about the activation, regulation of cellular metabolism.

Credits: 04 **Total Hours: 50**

UNIT	**CONTENTS**	**Hrs**	**CO**
I	Structure and organization of cytoskeleton - microfilaments, microtubules and intermediate filament. Structure and functions of nucleus, mitochondria, chloroplasts, endoplasmic reticulum and golgi apparatus- protein trafficking.	**10**	**CO1**
II	Cell cycle - Events and regulation in cell cycle. Microtubules and mitosis. Cell movements. Intracellular transport and the role of kinesin and dynein.	**10**	**CO2**
III	Ca++ dependent and independent cell-cell adhesion. Cell junctions and adhesion molecules, mitosis, meiosis, role of cyclins and cyclin dependent kinases, regulation of Cdk – cyclin activity.	**10**	**CO3**
IV	Signal transduction- G Protein couple receptors (GPCR), second messenger, role of cAMP and cGMP, steroid/peptide hormone regulation, tissue specific regulation - protein folding- molecular chaperones.	**10**	**CO4**
V	Cell division regulation and cancer. Role of protein kinases, Programmed cell death (PCD) - Autophagy and apoptosis. Geno toxicity assays.	**10**	**CO5**

Text Book:	
1.	*Ajoy Paul*. 2011. **Text Book of Cell and Molecular Biology**, Books and Allied Ltd., New Delhi.

Reference Books:	
1.	*Lodish, H., Berk A., Kaiser C. A., Krieger M., Scott M.P., Bretscher A., Ploegh H., and Matsudaira P.* 2008. **Molecular Cell Biology**, [Sixth Edition]. Freeman, W. H. and Co.
2.	*Geoffrey, M. Cooper and Hausman, R.E. 2007.* The cell **– A Molecular Approach.** [Fourth Edition]. ASM Press, Washington, D.C.
3.	*Sadava, D.E*. 2004. **Cell Biology: Organelle Structure and Function**. Reprint, [First Edition]. Panima Publishing Corp., India.

COURSE OUTCOMES (CO)

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

CO1	Recall about structural components and internal organelles.
CO2	Assess cell cycle and its regulations.
CO3	Analyze cell cycle mechanisms.
CO4	Apply cell signal transduction for design drugs.
CO5	Develop drugs for cancer therapy.

MAPPING

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

H-High; M-Medium; L-Low

18PMBMP201	**CORE PRACTICAL II (Soil and Agricultural Microbiology, Medical Microbiology, Environmental Microbiology and Cell biology)**	**SEMESTER II**

Course Objectives:

The course aims

- To understand and identify unknown pathogens.
- To study plant growth promoting microorganisms.

Credits: 04 **Total Hours: 60**

Experiment	**CONTENTS**	**Hrs**	**CO**
1.	Collection and transportation of clinical specimens.	**3**	**CO1**
2.	Isolation and Identification of bacteria causing urinary tract infection.	**2**	**CO1**
3.	Isolation and Identification of bacterial pathogens causing throat infection.	**5**	**CO1**
4.	Identification of unknown pathogen from pus from infected wound.	**5**	**CO1**
5.	Identification of unknown pathogen from blood sample.	**5**	**CO1**
6.	Identification of unknown pathogen from diarrheic stool.	**5**	**CO1**
7.	Isolation of *Rhizobium* from root nodules.	**5**	**CO2**
8.	Observation of VAM fungi from roots.	**5**	**CO2**
9.	Biological Oxygen Demand (BOD).	**5**	**CO3**
10.	Chemical Oxygen Demand (COD).	**2**	**CO3**
11.	MPN technique.	**3**	**CO3**
12.	Observation of mitosis from onion root tips.	**5**	**CO4**
13.	Observation of barr bodies from buccal smear.	**5**	**CO1**

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

COURSE OUTCOMES (CO)

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

CO1	Apply the diagnosis knowledge to detect the unknown pathogens from clinical samples.
CO2	Develop sustainable agriculture through study of agriculturally important microorganisms.
CO3	Evaluate the purity of the water and analyze the pollutants present in water bodies.
CO4	Assess the different molecular phases in eukaryotic cells.

18PBCMBI201	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: 02 **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	8	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	8	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 for occult	8	CO3

	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	**8**	**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	**8**	**CO5**
Text Books:			
1.	*Ramnik Sood.* 2006. **Medical Laboratory Technology.** [First Edition]. Jaypee Brother's Medical Publishers Ltd., New Delhi		
2.	*Kanai L. Mukherjee.* 2005. **Medical Laboratory Technology, Volume I.** Tata McGraw- Hill Publishing Co. New Delhi		

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	H	H	M	M
CO2	H	H	M	M	M
CO3	M	M	L	L	L
CO4	M	M	L	L	L
CO5	H	H	H	H	H

H-High; M-Medium; L-Low

18PBCMBIP201	**INTERDISCIPLINARY COURSE 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: 02 **Total Hours: 24**

S.No.	**EXPERIMENT**	**Hrs**	**CO**
I. Clinical haematology			
1.	Enumeration of WBC and RBC	3	CO1
2.	Estimation of haemoglobin (Sahli's method)	3	CO1
3.	Erythrocyte sedimentation rate (Westergren's method)	3	CO1
II. Blood analysis			
4.	Estimation of glucose in blood (Nelson Somogyi's method).	3	CO2
5.	Estimation of urea in blood (DAM method).	3	CO2
6.	Estimation of creatinine in blood (Jaffe's method).	3	CO2
III. Urine analysis			
7.	Estimation of creatinine in urine (Jaffe's method).	3	CO2
8.	Qualitative analysis of normal and abnormal constituents in urine	3	CO3

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

18PBTMBI201	IDC I: PLANT TISSUE CULTURE TECHNOLOGY	SEMESTER II

Course Objectives:

The course aims

- To understand the basic techniques in plant tissue culture.

Credits : 02 **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.	**7**	**CO1**
II	Callus and suspension culture, Micropropagation, Meristem culture, Somatic embryogenesis, Protoplast isolation, Fusion of protoplast, Somaclonal variations.	**8**	**CO2**
III	*Agrobacterium mediated* gene transfer, *Agrobacterium* based vectors, direct gene transfer methods - electroporation, microinjection, particle bombardment.	**9**	**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.	**6**	**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, NewYork.
4.	*Trivedi, P.C.* 2004. **Advances in Plant Physiology**. [Third Edition]. I.K. International Publications Pvt Ltd., New Delhi.

COURSE OUTCOMES (CO)

After the completion of the course the student 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

18PMBBTIP201	**INER 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: 02 **Total Hours:30**

Experiment	**CONTENTS**	**Hrs**	**CO**
1.	Media preparation.	**3**	**CO1**
2.	Hormone stock solution preparation	**2**	**CO1**
3.	Callus induction.	**5**	**CO1**
4.	Micropropagation.	**5**	**CO2**
5.	Protoplast isolation.	**5**	**CO2**
6.	Synthetic seed preparation	**5**	**CO2**

Reference Books:

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.
CO2	Cultivate the plant tissues/cells.
CO3	Synthesis seeds and hybridoma cells.

18PVE201	**VALUE EDUCATION: HUMAN RIGHTS**	**SEMESTER II**

Course Objectives

The course aims

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

Credits: 02 **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.	5	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.	5	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.	5	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.	**5**	**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.	**5**	**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.	3	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.	3	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.	3	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.	3	CO4
V	Avoid Pitfalls: of Beware Self-improvement - Facilitating Laboratory: Language Techniques and Concepts E-learning	3	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.

<table>
<tr><td>18PMBM301</td><td colspan="2">CORE VIII: GENETIC ENGINEERING</td><td>SEMESTER III</td></tr>
<tr><td colspan="4">Course Objectives:
The course aims
• To learn the basics of recombinant DNA technology.
• To acquire an idea about cloning mechanisms.</td></tr>
<tr><td colspan="2">Credits: 05</td><td colspan="2">Total Hours: 50</td></tr>
<tr><td>UNIT</td><td>CONTENTS</td><td>Hrs</td><td>CO</td></tr>
<tr><td>I</td><td>Introduction to Genetic Engineering: Definition, Historical perspectives. Enzymes in rDNA technology - Restriction enzymes – types – nomenclature. DNA ligase. DNA modifying enzymes – alkaline phosphatase and polynucleotide kinase- Polymerases and types- Conversion of blunt ended molecules to sticky ended- linkers – adopters – homopolymer tailing.</td><td>10</td><td>CO1</td></tr>
<tr><td>II</td><td>Cloning Vectors: Cloning vectors: Bacterial Plasmids- pBR322 & pUC vectors, Bacteriophage vectors λ, M13, Hybrid vectors- cosmid, phagemid. Yeast vectors- YEP, YRP, YIP & YAC. Shuttle vectors. Expression vectors for expressing eukaryotic gene.</td><td>10</td><td>CO2</td></tr>
<tr><td>III</td><td>Cloning Strategies: Construction of cDNA and genomic libraries. Gene transfer methods– transformation, electroporation, particle bombardment and microinjection. Screening and selection of clones.</td><td>10</td><td>CO3</td></tr>
<tr><td>IV</td><td>Transgenic Animals and Plants: Animal vectors – SV 40, Retroviral vector. Production and applications of transgenic mice. Gene transfer to plants- Callus culture, Agrobacterium mediated transformation: Crown gall disease, Ti plasmids,</td><td>10</td><td>CO4</td></tr>
</table>

	T-DNA transfer, Ti plasmid derivatives- co-integrate vectors and binary vectors.		
V	**rDNA technology**: Blotting techniques – Southern, Northern and Western blotting. PCR amplification and its application.DNA sequencing methods – dideoxy, chemical and Next Generation Sequencing (NGS), RFLP, RAPD, Microarray. Applications of Genetic Engineering in Medicine and Agriculture.	**10**	**CO5**
Text Books:			
1.	*Brown, T.A.* 1995.**Gene Cloning–An Introduction**. [Third Edition]. Chapmanand Hall, UK.		
2.	*Old, R.M. and Primrose, S.B.* 1995. **Principles of Gene Manipulation**. [Sixth Edition]. Blackwell Scientific Publication, London.		
Reference Books:			
1.	*Glick, B.K.* and *Pasternik, J.J.* 1998. **Molecular Biotechnology**. **Principles and applications of recombinant DNA**. [Second Edition]. ASM Press, Washington DC, USA.		
2.	*Winnacker, E.L.* 1987. **From Genes to Clones**. **Introduction to Gene technology**. [First Edition]. Panima Publishing Corporation, New Delhi.		

COURSE OUTCOMES (CO)

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

CO1	Recall the basics and importance of enzymes in molecular research.
CO2	Apply cloning for developing novel recombinant products.
CO3	Develop transformants for production of various pharmacologically important products.
CO4	Apply gene transfer technology for controlling plant diseases.
CO5	Demonstrate sequencing method for bacterial identification.

MAPPING

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

H-High; M-Medium; L-Low

<table>
<tr><td>18PMBM302</td><td colspan="2">CORE IX: BIOSTATISTICS AND RESEARCH METHODOLOGY</td><td>SEMESTER III</td></tr>
<tr><td colspan="4">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="2">Credits: 04</td><td colspan="2">Total Hours: 50</td></tr>
<tr><td>UNIT</td><td>CONTENTS</td><td>Hrs</td><td>CO</td></tr>
<tr><td>I</td><td>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>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.
Regression Analysis: Regression lines (except graphing) – Regression equations. (Volume 1: Chapters 8, 10 and 11)</td><td>10</td><td>CO2</td></tr>
</table>

III	**Test of Hypothesis:** Population – Sample – Procedure of testing hypothesis – Types of errors – Standard error - t 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	**Thesis Writing:** 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*. 2006. **Statistical Methods**. Sultan Chand and Sons Publishers, New Delhi. **(UNIT 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 revised 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**. NewAge Publications. New Delhi

COURSE OUTCOMES (CO)

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

CO 1	Learn the importance of statistics and Understand the concepts of measures of central tendency and measures of dispersion
CO 2	Gain knowledge on correlation and regression analyses
CO 3	Test the research statements through ANOVA.
CO 4	Select the appropriate procedure for carrying out their research work
CO 5	Understand the concepts in writing thesis, proposal and result interpretation

MAPPING

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

H-High; M-Medium; L-Low

18PMBMEL301	ELECTIVE II: BIOINFORMATICS, BIOETHICS AND IPR	SEMESTER III

Course Objectives:

The course aims

- To learn about the basics and scope of bioinformatics.
- To familiarize the prediction of various biological structures through bioinformatics tool.
- To know about the basics of intellectual property rights and bioethics.

Credits:05 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Bioinformatics:** Definition and Scope. Biological Databases – uses. Sequence Databases-Nucleic acid (NCBI, EMBL, DDBJ), Proteins - (SWISSPROT, PIR), Structural databases-PDB, CATH, SCOP, Specialized databases – KEGG, Pub Med.	**10**	**CO1**
II	**Sequence analysis:** Local Alignment, Global alignment-BLAST, Multiple sequence alignment - ClustalW, Phylogenetic analysis- WPGMA, UPGMA methods. Human Genome Project.	**10**	**CO2**
III	**Secondary structure prediction:** GOR, Chau-Fasman method, ORF finder, restriction site analysis, molecular visualization tool - Rasmol. Molecular Docking.	**10**	**CO3**
IV	**Biosafety and Bioethics**: Definition - DBT - Guidelines on Biosafety in conducting research in Biology/Biotechnology. Bioethics - Definition - Animal ethics - Norms in India - Licensing of animal house. Human ethics, Ethics of Research. Biosafety levels.	**10**	**CO4**

V	**Intellectual Property Rights:** WTO, GATT and TRIPS. Forms of IPR. Patents, copy rights, trade secrets. Patenting of biological materials. Patents of biotechnology in India. Plant breeders right. ICMR Guidelines.	**10**	**CO5**

Text Books:

1.	*Rastogi, S.C., N.Mendiratta and P.Rsatogi***. Bioinformatics- Methods and applications.** Third edition. PHI Learning Pvt Ltd, New Delhi.
2.	*Andreas, Baxevanis and Francis Ouellette.* **Bioinformatics- A practical guide to the analysis of genes & protein** [Second edition].
3.	*Shaleesha A. Stanley.* 2008. **Bioethics.** Wisdom educational service, Chennai.

Reference Books:

1.	*David H Mount.* **Bioinformatics**. *2005. Second Edn.* CBS Publishers, New Delhi.
2.	*Baruch A Brody and Tristram Engelhardt H. 1987.* **Bioethics: Readings and Cases.** Pearson education, UK.
3.	*Satheesh, M.K. 2008.* **Bioethics and Biosafety.** IK International Pvt. Ltd., New Delhi.

COURSE OUTCOMES (CO)

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

CO1	Recall the basics and applications of bioinformatics tools in molecular research.
CO2	Apply the sequence analysis for identification of microbes.
CO3	Develop the skill for protein characterization.
CO4	Demonstrate biosafety and ethics for the future sustainable development.
CO5	Apply intellectual property right for novel products.

MAPPING

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

H-High; M-Medium; L-Low

18PMBMEL302	**ELECTIVE II: PHARMACEUTICAL MICROBIOLOGY**	**SEMESTER III**

Course Objectives:

The course aims

- To learn about the synthetic antimicrobial agents and its mechanism of action.
- To understand microbial contamination and spoilage of various pharmaceutical products.
- To study the quality assurance and validation of pharmaceutical Industry.

Credits: 05 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Antibiotics:** Definition - Classification of antibiotics - Mechanism of action of antibiotics - Inhibitors of cell wall synthesis, nucleic acid and protein synthesis– Antimicrobial resistance. Scope and recent developments of pharmaceutical microbiology.	**12**	**CO1**
II	**Industrial production of microbial products:** Antibiotics – Penicillin and Streptomycin, vaccines – influenza, BCG.	**08**	**CO2**
III	**Microbial contamination and spoilage of pharmaceutical products:** sterile injectables – Intravenous infusions and total parenteral nutrition (TPN), non injectables–non injectable water and haemodialysis solutions, ophthalmic preparations and implants.	**10**	**CO3**
IV	**Pharmaceutical Drug Analysis:** Biosensors and applications in Pharmaceuticals; Macromolecular, cellular and synthetic drug carriers. Assay of steroids. Methods of preservation of pharmaceutical products.	**10**	**CO4**

V	**Quality Assurance and Validation:** Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) in Pharmaceutical Industry. Toxicology test of antimicrobial drugs – Acute toxic category and Fixed dose procedure. Laboratory evaluation and quality testing of antimicrobial drugs.	**10**	**CO5**
Text Book:			
1.	*Hugoand Russell.* 2004. **Pharmaceutical Microbiology.** [Seventh Edition]. Wiley- Blackwell Publishers, UK.		
Reference Books:			
1.	*Purohit,S.S., Saluja,A.K. and Kakrani,H.N.* 2003. **Pharmaceutical Microbiology**. Agrobios, New Delhi.		
2.	*Lansing M Prescott, John P Harley and Donald A Klein*. 2010. **Microbiology**. [Eighth Edition]. Mc Graw Hill, NewYork.		

COURSE OUTCOMES (CO)

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

CO1	Recall the basics and working mechanism of antibiotics against infectious diseases.
CO2	Optimize the production of pharmaceutical products.
CO3	Develop the pharmaceutical products without contamination and spoilage.
CO4	Apply the technology in drug delivery systems.
CO5	Follow the protocols and regulations to validate pharmaceutical products.

MAPPING

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

H-High; M-Medium; L-Low

18PMBMP301	**CORE PRACTICAL III (Genetic Engineering, Industrial Microbiology, and Food and Dairy Microbiology)**	**SEMESTER III**

Course Objectives:

The course aims

- To understand molecular techniques for nucleic acid and protein analysis.
- To study the quality of the milk by standard protocols.

Credits: 03 **Total Hours: 60**

Experiment	**CONTENTS**	**Hrs**	**CO**
1.	Isolation of Genomic DNA.	**5**	**CO1**
2.	Isolation of Plasmid DNA.	**5**	**CO2**
3.	Protein profiling – SDS-PAGE.	**5**	**CO3**
4.	Polymerase Chain Reaction.	**5**	**CO3**
5.	Restriction digestion	**5**	**CO3**
6.	Isolation of mutants by replica plating and gradient plate technique	**5**	**CO3**
7.	Bacterial conjugation	**5**	**CO3**
8.	Bacterial transformation and competent cell formation		**CO3**
9.	Western blotting	**5**	**CO3**
10.	Partial purification of enzymes by dialysis	**5**	**CO3**
11.	Methylene Blue Reduction Test (MBRT)	**3**	**CO4**
12.	Assessment of milk quality by Phosphatase test	**3**	**CO4**
13.	Examination of milk by Breeds count method	**3**	**CO4**
14.	Solid state fermentation of citric acid from *Aspergillus niger*	**3**	**CO5**
15.	Amylase production by Submerged fermetation	**3**	**CO5**

Reference Book:

1. *Gakhar, S.K. and Monica Miglani* 2013. **Molecular Biology: A Laboratory manual**. I.K. International house, Mumbai.

COURSE OUTCOMES (CO)

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

CO1	Analyze the bacterial genomic DNA and RNA.
CO2	Evaluate the molecular weight of proteins.
CO3	Apply the molecular techniques for protein analysis.
CO4	Evaluate and analyze the purity of milk.
CO5	Demonstrate the economically important microbial products.

18PMBMP302	**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: 02 **Total Hours: 24**

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

Reference Books:

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)

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

CO 1	Demonstrate the data in diagrammatic and graphical representation
CO 2	Find the averages and measures dispersion
CO 3	Calculate correlation and regression for huge amount data
CO 4	Gain knowledge about test of significance

18PBCMBI301	INTERDISCIPLINARY COURSE II: PHARMACEUTICAL BIOCHEMISTRY	SEMESTER III

Course Objectives:

The course aims

- Pharmacodynamics and pharmacokinetics of drugs.
- Plant therapeutics

Credits: 02 **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	8	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)	8	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)	8	CO3
IV	Phytomedicine: History, Definition and Scope of Phytomedicine. Indian Medicinal systems– Ayurveda, Siddha	8	CO4

	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.		
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).	**8**	**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	M	M	M	M	M
CO2	M	M	M	M	M
CO3	M	M	M	M	M
CO4	H	H	H	H	H
CO5	H	H	H	H	H

H-High; M-Medium; L-Low

18PBCMBIP301	**INTERDISCIPLINARY 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: 02 **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	3	1
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	6	1
3.	Quantitative estimation of proteins (Lowry's method).	3	2
4.	Quantitative estimation of carbohydrates (Anthrone method).	3	2
5.	Quantitative estimation of phenols (Singleton and Rossi's method).	3	2
6.	Isolation and partial purification of phytoconstituents (Phenol and Flavonoids) using Chromatographic techniques (TLC)	6	2

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

18PBTMBI301	INTER DISCIPLINARY COURSE II: ANIMAL CELL CULTURE TECHNOLOGY	SEMESTER III

Course Objectives

The course aims

To understand the basic techniques in Animal cell culture.

Credits: 02 **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	Glassware 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 the completion of the course the student 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	The differentiation of 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	**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: 02 **Total Hours: 20**

Experiment	**CONTENTS**	**Hrs**	**CO**
1.	Sterilization techniques in Animal cell culture.	**3**	**CO1**
2.	Media preparation for Animal Cell Culture.	**2**	**CO1**
3.	Primary culture of Chick embryo fibroblast.	**5**	**CO2**
4.	Trypsinization and subculturing.	**5**	**CO2**
5.	Determination of viability of cells using Trypan blue stain.	**5**	**CO2**

Reference Books:

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	Analyze viable cells

18PMBM401	CORE X: INDUSTRIAL MICROBIOLOGY	SEMESTER IV

Course Objectives:

The course aims

- To acquire an overview about the industrial processes.
- To understand the design of fermenters and its components.

Credits: 04 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**An introduction to fermentation process:** Range of fermentation process – Component parts of a fermentation process – Screening of industrial microorganisms– primary screening – Crowded plate method, auxanography, indicator dye and enrichment. Secondary screening. Preservation of microorganisms - refridgerated storage, lyophilization, cryogenic storage.	10	CO1
II	**Strain improvement and Media formulation:** mutation – ionizing and non-ionizing radiation – rDNA technology. Strain development technique – bacteria, fungi and yeast. Medium formulation and sterilization – batch, continuous. Del factor. Types of fermentation –submerged – solid state fermentation.	10	CO2
III	**Instrumentation and control of fermentor:** Body construction – aeration and agitation. Stirrer glands and bearings – baffles. Maintenance of aseptic conditions – sterilization of fermenter, air supply. Types of fermentor – tower, cylindro-conical, air-lift – inner - outer. Measurement and control - Temperature, pH and Foam.	10	CO3
IV	**Microbial production**: Antibiotics – Penicillin and	10	CO4

	Streptomycin. Organic acids – Citric acid and Acetic acid. Enzymes – Amylase and Protease. Yeast – Brewer's and Baker's.		
V	**Production and recovery:** Solvents – Ethyl alcohol, 2,3 Butanediol. Aminoacids – L-Glutamic acid and L-Lysine. Vitamins – B_{12} and C. Downstream processing.	**10**	**CO5**
Text Books:			
1.	*Stanbury, P.F., Whittaker, A. and Hall, S.J.* 1997. **Principles of Fermentation Technology.** [Second Edition]. Reed Elsevier India Pvt. Ltd., New Delhi.		
2.	*Patel, A.H., 2005*. **An Introduction to Industrial Microbiology.** Macmillan India Ltd., Chennai.		
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.	*Cruegar, W and Cruegar, A.* 1989. **Biotechnology**: **A Textbook of Industrial Microbiology**. Panima Publishing Corporation, New Delhi.		

COURSE OUTCOMES (CO)

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

CO1	Understand and screen the industrial important microorganisms.
CO2	Develop strain improvement and media formulation.
CO3	Demonstrate the maintenance and design of the fermenter.
CO4	Apply the recovery process for purification process of intra and extra cellular products.
CO5	Understand the physical, chemical and biological methods of effluent treatment.

MAPPING

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

H-High; M-Medium; L-Low

18PMBM402	**CORE XI: FOOD AND DAIRY MICROBIOLOGY**	**SEMESTER IV**

Course Objectives:

The course aims

- To learn the basics of recombinant DNA technology.
- To acquire an idea about cloning mechanisms.

Credits: 05 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Introduction:** Importance of food and dairy Microbiology– Types of microorganisms in food – Source of contamination (primary sources) – Factors influencing microbial growth in foods (extrinsic and intrinsic).	**10**	**CO1**
II	**Spoilage and preservation of different kinds of foods:** cereals and cereal products– milk and milk products – vegetable and fruits–meat and meat products– fish and eggs.	**10**	**CO2**
III	**Food borne infections and intoxications:** bacterial, non-bacterial (*Staphylococcus*, *Clostridium*, *Escherichia coli* and *Salmonella* infections, Hepatitis, Amoebiosis and Mycotoxins)–Food borne disease outbreaks– Laboratory testing–preventive measures.	**10**	**CO3**
IV	**Food preservation:** Principles of food preservation–methods of preservation. Physical methods (irradiation, drying, heat processing, chilling and freezing, modification of atmosphere) and Chemical preservatives.	**10**	**CO4**
V	**Fermented food products:** Bread, Sauerkraut, cheese, Yoghurt, Buttermilk and Tempeh. Food sanitation and its control.	**10**	**CO5**

Text Book:

1. *Frazier, W.C. and Westhoff, D.C.* 2001. **Food Microbiology**. [Fourth Edition].

	Tata McGraw-Hill Publishing Company Limited, New Delhi.

Reference Books:	
1.	*Banwart, G.J.*1989. **Basic Food Microbiology.** Chapman and Hall New York.
2.	*Jay,J. M.* 1987. **Modern Food Microbiology**. CBS Publishers and distributors, New Delhi.
3.	*Adams, M.R. and Moss*, *M.O.* 1995. **Food Microbiology.** The Royal Society of Chemistry, Cambridge.

COURSE OUTCOMES (CO)

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

CO1	Discuss importance of food in dairy microbiology.
CO2	Understand the spoilage of food products for product development.
CO3	Analyze food borne infections and intoxications for product preservation.
CO4	Evaluate different kinds of food preservation methods for product safety.
CO5	Demonstrate various fermented food products.

MAPPING

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

H-High; M-Medium; L-Low

GUIDELINES

1. SUBMISSION OF RECORD NOTE BOOKS AND PROJECT DISSERTATION:

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

2. PASSING MINIMUM AND INTERNAL MARK DISTRIBUTION:

(Theory, Practical and Project)

(i) A. THEORY (If Internal Evaluation is for 25 Marks)

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

Internal Marks Distribution [CA- Total Marks: 25]

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

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

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

Internal Marks Distribution [CA- Total Marks: 100]

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

ii) PRACTICAL

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

Internal Marks Distribution [CA- Total Marks: 40]

Experiment	: 10 Marks (10-12 Experiments)
Attendance	: 5 Marks
Record	: 5 Marks
Internal Examinations	: 20 Marks
Total	**: 40 Marks**

(iii) ***Assessment of technical skill*** **(internal evaluation only)**

Student shall attend two online tests (with multiple choice question) regarding soft skill, the marks and it might be converted to 60. Each student should score a minimum of 50 as pass mark.

Technical Skill: CSIR, ICMR, UGC – NET (Online test)

Assignment (2)	: 30 Marks
Test (2)	: 60 Marks
Attendance	: 10 Marks
Total	**: 100 Marks**

(iv) Assessment of Internship Training

Student should attend the internship training after the completion of II semester examinations. He/ She shall obtain the certificate for the period of training from the competent authority and submit the summer training report during III semester. He/She shall make a presentation and it should be assessed internally by the Department.

Attendance (Certificate given by the appropriate designated authority)	: 10 Marks
Submission Training report	: 50 Marks

Presentation of the training report	: 20 Marks
Viva-Voce	: 20 Marks
Total	**: 100 Marks**

(v) ***Project Work/Dissertation***

- The project work shall be carried out by each student in the IV semester and has to complete the work at the end Semester.
- Upon completion of the project work/dissertation the candidate will be required to appear for a viva-voce conducted by an external examiner.
- The Student has to attend 3 reviews before completing his/her Project.
- All 3 reviews will be reviewed by department faculty members.
- 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 secure not less than 100 marks put together out of 200 in the Comprehensive Examination in each Project with a passing minimum of 75 marks in External out of 150.

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

Research work done	: 20 Marks
Attendance	: 5 Marks
Observation Note	: 10 Marks
Review	: 15 Marks (Three reviews)
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**

CAREER COMPETENCY SKILLS
METHODOLOGY OF ASSESSMENT

1. On Line Objective Examination (Multiple Choice questions) - Semester I

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

2. Viva Voce Semester II

- 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.

3. QUESTION PAPER PATTERN AND MARK DISTRIBUTION
THEORY

Question Paper Pattern and Mark Distribution **(For 75 marks)**

1. PART – A (5 x 5 = 25 Marks)
Answer ALL questions
One question from each UNIT with Internal Choice
2. PART – B (5 x 10 = 50 Marks)
Answer ALL questions
One question from each UNIT with Internal Choice

Question Paper Pattern and Mark Distribution **(For 100 marks)**

1. PART – A (5 x 5 = 25 Marks)
Answer ALL questions
One question from each UNIT with Internal Choice
2. PART – B (5 x 15 = 75 Marks)
Answer ALL questions
One question from each UNIT with Internal Choice

INTER DISCIPLINARY COURSES (IDC) OFFERED TO OTHER DEPARTMENTS

S.NO.	SUBJECT CODE	SEMESTER	SUBJECT	OFFERED TO THE STUDENTS OF
1.	18PMBBCI201/ 18PMBBTI201	II	IDC I : Clinical Microbiology	M.Sc. Biochemistry/ M.Sc. Biotechnology
2.	18PMBBCIP201/ 18PMBBTIP201		IDC Practical I: Clinical Microbiology	M.Sc. Biochemistry/ M.Sc. Biotechnology
3.	18PMBBCI301/ 18PMBBTI301	III	IDC II: Industrial Microbiology	M.Sc. Biochemistry/ M.Sc. Biotechnology
4.	18PMBBCIP301/ 18PMBBTIP301		IDC Practical II: Industrial Microbiology	M.Sc. Biochemistry/ M.Sc. Biotechnology

18PMBBCI201/ 18PMBBTI201	**IDC I: CLINICAL MICROBIOLOGY**	**SEMESTER II**

Course Objectives:

- 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: 02 **Total Hours: 40**

UNIT	CONTENTS	Hrs	CO
I	**Infection: S**ources 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 samples:** 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 Books:	
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**. Volume II: Microbiology. ELBS Publishers.
3.	*Sathyanarayana, U*. 2010. **Biotechnology**. Books and Allied (P) Ltd, Kolkatta.

Reference Books:	
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 completion of the course, the students 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

18PMBBCIP201/ 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: 02 **Total Hours:20**

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

18PMBBCI301/ 18PMBBTI301	**INTER DISCIPLINARY COURSE II : INDUSTRIAL MICROBIOLOGY**	**SEMESTER III**

Course Objectives:

The course aims

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

Credits: 02 **Total Hours: 40**

UNIT	CONTENTS	Hrs	CO
I	**An introduction to fermentation process:** Historical development of industrial microbiology– Component parts of a fermentation process – Screening of industrial microorganisms– primary screening – Crowded plate method, auxanography, indicator dye and enrichment. Secondary screening. Preservation of microorganisms - lyophilization, cryogenic storage.	**8**	**CO1**
II	**Strain improvement and Media formulation:** rDNA technology. Medium formulation and sterilization – batch, continuous. Types of fermentation –submerged – solid state fermentation.	**8**	**CO2**
III	**Fermentor:** components and 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.	**8**	**CO3**
IV	**Microbial production of fermented products**: Antibiotics – Penicillin .Organic acid – Citric acid. Vitamin – Vitamin B12. Enzyme – α-amylase. Wine.	**8**	**CO4**

V	**Production and recovery:** Solvents – Ethyl alcohol. Aminoacids –L-Lysine. Vitamins – B_{12}. Downstream processing.	**8**	**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 the completion of the course, the student 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 *invitro* 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

18PMBBCIP301/ 18PMBBTIP301	**IDC PRACTICAL II: INDUSTRIAL MICROBIOLOGY**	**SEMESTER II**

Course Objectives:

The course aims

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

Credits: 02 **Total Hours:30**

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