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 COURSE

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

OBJECTIVE OF THE COURSE

- The two year M.Sc., program is designed to create innovative & versatile personality students in the field of microbiology through our quality education.

- The ultimate aim is to enable the students to develop an interdepartmental approach for understanding the life science problems at the molecular level. In addition, the present curriculum gives scope for vertical and horizontal mobility in the education system so that the students can enter different modules to update their knowledge depending upon the employment opportunities in each area.

- Various IDC, elective subjects and practical courses have been designed to train them for successful entrepreneur. The practical training will develop their reasoning ability and make them fit for industrial need.

SCHEME OF EXAMINATION

Subject Code	Subject	Hours of Instruction	Exam Duration	Maximum Marks			Credit Points
				CA	CE	Total	
FIRST SEMESTER							
Part A							
15PMBM101	Core I: Fundamentals of Microbiology & Microbial Physiology	5	3	25	75	100	4
15PMBM102	Core II: Cell Biology	5	3	25	75	100	4
15PMBM103	Core III: Microbial Genetics	5	3	25	75	100	5
15PMBM104	Core IV: Biochemistry	6	3	25	75	100	5
15PMBMP101	Core Practical I	6	9	40	60	100	3
Non Credit							
15PLS101	Career Competency Skills I	1	-	-	-	-	-
	Total	**28**				**500**	**21**
SECOND SEMESTER							
Part A							
15PMBM201	Core V: Immunology	4	3	25	75	100	4
15PMBM202	Core VI: Medical Microbiology	5	3	25	75	100	5
15PMBM203	Core VII: Microbial Taxonomy and Diversity	5	3	25	75	100	4
15PMBM204	Core VIII: Food Microbiology (Self Study and 100% External Evaluation)	-	3	-	100	100	4
15PMBMP201	Core Practical II	5	9	40	60	100	3
Optional Subjects							
15PBCMBI201	IDC I: Diagnostic Biochemistry	3	3	25	75	100	3
15PBCMBIP201	IDC Practical I: Diagnostic Biochemistry	2	3	40	60	100	2
15PBTMBI201	IDC I: Plant Tissue Culture Technology	3	3	25	75	100	3

15PBTMBIP201	IDC Practical I: Plant Tissue Culture Technology	2	3	40	60	100	2
Part B							
15PVE201	Value Education : Human Rights	2	3	25	75	100	2
15PMBTS201	Technical skill: CSIR/ICMR/UGC-NET (online)	1	-	-	100	100	1
Non Credit							
15PLS201	Career Competency Skills II	1	-	-	-	-	-
	Total	**28**				**900**	**28**
THIRD SEMESTER							
Part A							
15PMBM301	Core IX: Genetic Engineering	5	3	25	75	100	5
15PMBM302	Core X: Molecular Biology	4	3	25	75	100	4
15PMBM303	Core XI: Industrial Microbiology	4	3	25	75	100	4
15PMBM304	Core XII: Bioinstrumentation	4	3	25	75	100	4
	Elective	3	3	25	75	100	3
15PMBMP301	Core Practical III	5	9	40	60	100	3
Optional Subjects							
15PBCMBI301/ 15PBCBTI301	IDC II: Pharmaceutical Biochemistry	3	3	25	75	100	3
15PBCMBIP301/ 15PBCBTIP301	IDC Practical II: Pharmaceutical Biochemistry	2	3	40	60	100	2
15PBTMBI301/ 15PBTBCI301	IDC II: Animal Tissue Culture Technology	3	3	25	75	100	3
15PBTMBIP301/ 15PBTBCIP301	IDC Practical II: Animal Tissue Culture Technology	2	3	40	60	100	2

Part B							
15PMBIT301	Internship Training	-	-	-	100	100	2
	Total	**30**				**900**	**30**
FOURTH SEMESTER							
Part A							
15PMBM401	Core XIII: Biostatistics and Research Methodology	5	3	25	75	100	4
15PMBM402	Core XIV: Bioinformatics, Bioethics and IPR (Internal)	5	3	100	-	100	4
15PMBPR401	Project & Viva -Voce	-	-	50	150	200	8
	Total	**10**	**-**			**400**	**16**
Grand Total						**2700**	**95**

For Course Completion, students shall complete all the subjects in Part A and B.

The students shall choose any one of the following Elective subject in the third semester

S.NO	SUBJECT CODE	SUBJECT
1	15PMBEL301	Diagnostic Microbiology
2	15PMBEL302	Agricultural Microbiology

TOTAL MARKS AND CREDIT DISTRIBUTION

S.NO	COMPONENET	MARKS	CREDITS
1.	PART A: Core, Elective and IDC subjects	2400	90
2.	PART B: Internship Training, Value Education and Technical Skill	300	05
TOTAL		**2700**	**95**

15PMBM101	CORE I : FUNDAMENTALS OF MICROBIOLOGY & MICROBIAL PHYSIOLOGY	SEMESTER - I

Total Hours: 50

OBJECTIVES:

1. To learn the Basics of Microbiology.
2. To acquire the knowledge about microbial media and sterilization.
3. To study the cell structure, microbial nutrition and growth.

CONTENTS

UNIT – I **(10 Hours)**

Spontaneous generation theory – Contribution to microbiology by Anton Van Leeuwenhoek, Louis Pasteur, Robert Koch, Alexander Fleming, Joseph Lister, 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 & S layers). Pili and fimbriae. Flagella. Chemotaxis. Bacterial endospores.

UNIT – II **(10 Hours)**

Microbial structure - Bright Field Microscope – Resolution, Numerical Aperture. Types of Microscopes - Dark field microscope, Phase Contrast Microscope, Fluorescent Microscope. Electron Microscope – SEM, TEM- Confocal Microscope. Stains and staining reactions: Fixation - dyes and stains - simple staining, differential, acid fast, capsule, endospore, flagella.

UNIT – III **(10 Hours)**

Microbial nutrition – Nutritional requirements, nutritional types of microorganisms. Uptake of nutrients – passive diffusion, facilitated diffusion, active transport, group translocation, ion uptake. Types of Media - Simple Media, Complex Media, Selective Media, Enriched Media, Differential Media. Pure cultures techniques – Spread Plate, Streak Plate and Pour Plate.

UNIT – IV **(10 Hours)**

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, cell mass. Continuous culture – Chemostat,

turbidostat; Synchronous culture. Various factors on growth – physical and chemical.

UNIT – V **(10 Hours)**

Catabolic metabolism – the nature of metabolism, central pathway of metabolism, common biosynthetic intermediates – The Embden-Meyerhof-parnas pathway, The Enter-Doudoroff, citric acid cycle, Electron transport chain and ATP generation, Photosynthesis.

TEXT BOOKS:

1. *Prescott, L.M., Harley, J.P and Klein, D.A.* 2012. **Microbiology.** [Eighth Edition]. WMC. Brown Publishers. **[Unit I, II & III]**
2. *Salle, A.J.* 2001. **Fundamental Principles of Bacteriology**. [Seventh Edition]. Tata McGraw-Hill, New Delhi. **[Unit IV & V]**

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 & Bartlett Publishers, New York.
3. *Hans G Schlegel.* 2003. **General Microbiology**. [Seventh Edition]. Cambridge University Press, UK.

15PMBM102	CORE II : CELL BIOLOGY	SEMESTER - I

Total Hours: 50

OBJECTIVES:

1. Ascertain the cellular level organization and its functions
2. Learn about the activation, regulation of cellular metabolism.

CONTENTS

UNIT – I **(10 Hours)**

Structural organization of: Cytoskeleton (structural proteins – microfilaments, actins, etc.); nucleus, Mitochondria and chloroplasts and their genetic organization, Endoplasmic Reticulum, Golgi apparatus, Protein trafficking; Events in cell cycle, Regulation of cell cycle.

UNIT – II **(10 Hours)**

Microfilaments, intermediate filaments and microtubules – structure and dynamics. Microtubules and mitosis; cell movements. Intracellular transport and the role of kinesin and dynein.

UNIT – III **(10 Hours)**

Ca++ dependent cell-cell adhesion; Ca++ independent cell- cell adhesion. Cell junctions and adhesion molecules, Mitosis, meiosis, cell cycle, role of cyclins and cyclin dependent kinases, regulation of Cdk – Cyclin activity.

UNIT – IV **(10 Hours)**

Signal transduction, G- Protein couple receptors (GPCR), second messenger, Role of cAMP and cGMP, Steroid/peptide hormone regulation, tissue specific regulation, protein kinase. Protein folding, Molecular chaperones.

UNIT – V **(10 Hours)**

Cell division regulation and cancer. Role of protein kinases. Autophagy, Programmed cell death (PCD). Geno toxicity assays.

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. *Roberts, K., Lewis J., Alberts B., Walter P., Johnson A., and Raff. M.* 2008. **Molecular Biology of the cell**, [Fifth Edition], Garland Publishing Inc.

15PMBM103	CORE III : MICROBIAL GENETICS	SEMESTER - I

Total Hours: 50

OBJECTIVES:

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

CONTENTS

UNIT - I **(10 Hours)**

Organization of Prokaryotic and Eukaryotic genome. Nucleic acids- Structure of DNA, types of DNA, Chargaff rule and types of RNA. DNA repair –Biological indication of repair, Biochemical mechanisms for repair of thymine dimers- Light and Dark repair.

UNIT - II **(10 Hours)**

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, Gradient plate method. Carcinogenicity test.

UNIT – III **(10 Hours)**

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.

UNIT - IV **(10 Hours)**

Plasmids - General properties and types of plasmids. Properties of particular plasmids – the sex plasmid F and its derivatives, the drug-resistance (R) plasmids, the Col plasmid, Ti plasmid. Transposable Elements – Definition, types of bacterial transposons, mechanism of transposition.

UNIT - V **(10 Hours)**

Genetic recombination- mechanism of general recombination (Holliday model), site specific recombination.

TEXT BOOKS:

1. *Robert K Weaver* and *Philip W Hedrick.* **Genetics.** [Third Edition]. WMC.Brown Publisher. Singapore. **[Unit IV & V]**
2. *Benjamin Lewin.* 2008. **Genes IX.** Jones and Bartlett Publishers. Singapore. **[Unit I, II & III]**

REFERENCE BOOKS:

1. *Gardner, E.J.* 1991. **Principles of Genetics**. [Eighth edition]. John Wiley & sons Inc.
2. *Russel, P.J.* **Genetics**. 1996. [Fourth edition]. Harper Collins College Publications.

15PMBM104	CORE IV : BIOCHEMISTRY	SEMESTER - I

Total Hours: 50

OBJECTIVES:

1. To make the students aware about the role of biochemistry in microbial metabolism.
2. To expose the various pathways involved in microbial metabolism.

CONTENTS

UNIT – I **(10 Hours)**

Introduction – Biochemistry as molecular logic of living organisms, water: the solvent of life. pH and buffer, atom and chemical bond, osmosis and osmotic pressure, surface tension, viscosity, colloids.

UNIT – II **(10 Hours)**

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.

UNIT – III **(10 Hours)**

Carbohydrates – isomerism, epimers. Classification - general structure of monosaccharide, disaccharide, polysaccharide. Aminosugars, glycoproteins, mucopolysaccharides, carbohydrate in cell membrane.

UNIT – IV **(10 Hours)**

Nucleic acid – chemistry of DNA and RNA. DNA and gene – biological importance of nucleic acids. Proteins – Classification – structure of proteins – primary, secondary, tertiary and quaternary. Structure of proteins related to its biological function, principles of determination of molecular weight of proteins, denaturation of proteins.

UNIT – V **(10 Hours)**

Lipids **–** Classification - simple lipids, compound lipids, glycolipids, amino lipid, lipoproteins, derived lipids, saturated fatty acids, prostanoids, essential fatty acids, steroids.

TEXT BOOKS:

1. *Deb, A.C.* 2006. **Fundamentals of Biochemistry.** New Central Book Agencies Pvt. Ltd., Kolkatta. **[Unit I & III]**
2. *Jain, J.L., Sunjay Jain and Nitin Jain*. 2008. **Fundamentals of Biochemistry**. S. Chand and Company Ltd., New Delhi. **[Unit II, IV & V]**

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. *Jeremy M Berg., John L Tymoczko and Lubert Stryer*. 2002. **Biochemistry** [Fifth edition]. W H Freeman & Co., New York.

15PMBMP101	CORE PRACTICAL I	SEMESTER - I

Fundamentals of Microbiology & Microbial Physiology, Microbial Genetics, Cell Biology, Biochemistry

LIST OF EXPERIMENT

1. Microscopy – Micrometry.
2. Preparation of solid media: deeps, slants and plates.
3. Pure culture techniques.
4. Motility – Hanging drop technique, observation on plates and in soft agar deeps.
5. Measurement of bacterial growth – Growth curve.
6. Simple staining.
7. Capsular staining**.**
8. Gram staining.
9. Endospore staining.
10. Acid-fast staining.
11. The effect of temperature on growth.
12. Mitosis and the Cell Cycle in Onion Root-Tip Cells
13. Mitochondria isolation
14. Buccal smear – Identification of Barr Body
15. IMViC test.
16. Carbohydrate fermentation.
17. Triple sugar iron (TSI) agar test.

REFERENCE BOOK:

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

15PLS101	CAREER COMPETENCY SKILLS I	SEMESTER – I

Total Hours: 15

OBJECTIVE:

To enhance employability skills and to develop career competency

CONTENTS

UNIT – I **(3 Hours)**

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

UNIT – II **(3 Hours)**

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

UNIT – III **(3 Hours)**

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

UNIT – IV **(3 Hours)**

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

UNIT – V **(3 Hours)**

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

15PMBM201	CORE V : IMMUNOLOGY	SEMESTER - II

Total Hours: 50

OBJECTIVES:

1. To learn the working of immune system and immune complexes.
2. To understand the mechanisms of immune response, autoimmune disorders.

CONTENTS

UNIT – I **(10 Hours)**

Historical perspective of Immunology. Hematopoiesis - Cells of the immune system –Organs of the immune system – Primary and Secondary lymphoid organs. Clonal selection theory. Innate immunity, Acquired Immunity, Active and passive – Humoral and cell mediated immunity.

UNIT – II **(10 Hours)**

Antigens – Factors influencing immunogenicity – Epitopes, Haptens, Adjuvants. Immunoglobulins – Basic structure and Classes – Diversity. Monoclonal antibodies – Production, Formation and clinical uses. Antigen – Antibody reactions – Agglutination, Precipitation, Complement fixation, Immunofluorescence, ELISA, Radio Immuno Assay.

UNIT – III **(10 Hours)**

Antigen processing and Histocompatability complex – Antigen processing cells, Major Histocompatibility complex – Structure and functions - Processing of exogenous and endogenous antigens - Class I, Class II and Class III molecules. T – Cell receptor – structure, organization and maturation. Cytokines – Structure and functions.

UNIT – IV **(10 Hours)**

Complement activation – classical, Alternative and terminal complement pathways. Hypersensitive reactions – Classification – IgE mediated (type –I), Antibody mediated cytotoxic (Type –II), Immune complex mediated (Type III), T_{DTH} - Mediated (Type IV). Vaccines – Active and Passive immunization, Types of Vaccines – polysaccharide, toxoid and recombinant vaccines.

UNIT – V **(10 Hours)**

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.

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. **[Unit I, II & III]**
2. *Tizard, K.* 2004. **Immunology – An Introduction**. Saunders College, Philadelphia. **[Unit IV & V]**

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.

15PMBM202	CORE VI : MEDICAL MICROBIOLOGY	SEMESTER - II

Total Hours: 50

OBJECTIVES:

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

CONTENTS

UNIT – I **(10 Hours)**

Morphology, cultural characteristics, pathogenesis, laboratory diagnosis, control of - *Staphylococcus aureus, Streptococcus pneumoniae, Neisseria gonorrhoea, Corynebacterium diphtheriae, Mycobacterium tuberculosis, Clostridium tetani, Bacillus anthracis.*

UNIT – II **(10 Hours)**

Morphology, cultural characteristics, pathogenesis, laboratory diagnosis, control of - *Escherichia coli, Klebsiella sp., Proteus sp., Salmonella sp., Shigella sp., Vibrio cholerae, Pseudomonas aeruginosa, Haemophilus influenza*, *Listeria monocytogenes, Rickettsia, Chlamydiae trachomatis.*

UNIT –III **(10 Hours)**

Superficial mycosis -Tinea, Piedra. Cutaneous mycosis - Dermatophytoses, Systemic mycosis - Blastomycosis and Histoplasmosis. Subcutaneous mycosis -Sporotrichosis, Opportunistic mycosis – *Candida, Cryptococcus* and *Aspergillus*. Antifungal agents.

UNIT – IV **(10 Hours)**

Introduction to Medical Virology – Morphology, pathogenesis, clinical manifestation and diagnosis of viruses: Ebola, Influenza, Hepatitis A & B, Rabies, Human Papiloma Virus, Herpes virus and HIV.

UNIT – V **(10 Hours)**

Introduction to Medical Parasitology - Morphology, life cycle, pathogenesis, clinical manifestation and diagnosis of parasites: *Ancyclostoma duodenale, Ascaris lumbricoides, Entamoeba histolytica, Giardia lamblia, Plasomodium vivax, Taenia solium* and *Wuchereria bancrofti.*

TEXT BOOKS:

1. *Ananthanarayan, R. and Jayaram Panicker, C.K.* 2005. **Text Book of Microbiology.** [Seventh Edition]. Orient Longman Pvt. Ltd., Chennai. **[Units I & II]**
2. *Murray, M.R, Rosenthal, K.S, and Michael A Pfaller*. 2005. **Medical Microbiology.** Elsevier, Pennsylvania, USA. **[Units IV]**
3. *Subhash Chandra Parija*, 2004. **Text book of Medical Parasitology –** Protozoology and Helminthology. 2nd edition, published by All India Publishers and Distributors, Medical book publisher, New Delhi. **[Unit V]**
4. *Jegadish Chander*, 1996. **A Text Book of Medical Mycology**. Interprint, New Delhi. **[Unit III]**

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.

15PMBM203	CORE VII : MICROBIAL TAXONOMY AND DIVERSITY	SEMESTER – II

Total Hours: 50

OBJECTIVES:

1. To impose a broader idea about the positional classification of various microbes.
2. To understand the evolutionary concepts, phylogeny and diversity of microorganisms.

CONTENTS

UNIT – I **(10 Hours)**

Microbial evolution and phylogeny – phylogeny of microorganisms. Classification – Taxonomy hierarchy. Haeckel's three Kingdom classification - Whittaker's five Kingdom classification system, Classical systems of classification – dichotomous, numerical taxonomy, molecular based classification (rRNA).

UNIT – II **(10 Hours)**

Bergey's manual of determinative bacteriology. Phylogenetic group of bacteria – Aquificales, Thermotogales, Green non-sulphur bacteria, Deinococci, Proteobacteria. Gram positive bacteria, Cyanobacteria, Chlamydiae. Phylogenetic groups of archaea.

UNIT – III **(10 Hours)**

Bacterial diversity: Spirochetes, Pseudomonas, Methylotrophic bacteria. Enterobacteriaceae, Vibrionaceae, Phototrophic bacteria. Cyanobacteria – Budding and appendaged bacteria – sheathed bacteria.

UNIT – IV **(10 Hours)**

Gram positive cocci and spore forming bacteria. Asporogenous Gram positive rods – regular non spore forming Gram positive rods – irregular non spore forming Gram positive rods – Mycobacteria.

UNIT – V **(10 Hours)**

Actinomycetes – Morphological and biochemical differentiation of Actinomycetes – Taxonomic group of actinomycetes – methanogens – methanotrophs.

TEXT BOOK:

1. *Atlas, R.M.* 1997. **Principles of Microbiology.** [Second Edition]. WCK. McGraw – Hill.

REFERENCE BOOKS:

1. *Madigan, M.T. Martinko, J.M. and Parker, J.* 2000. **Brock Biology of Microorganisms.** [Ninth Edition]. Prentice Hall International, Inc.
2. *Balows, A. Truper, H.G. Devorkin, M. Harder and Schleife, K.H.* 1992. **The Prokaryotes.** Springerlink. New York.

15PMBM204	CORE VIII : FOOD MICROBIOLOGY	SEMESTER – II

Total Hours: 50

OBJECTIVE:

1. To give knowledge on basics in food microbiology, Food borne pathogens, Food preservation and Food quality control.

CONTENTS

UNIT – I **(10 Hours)**

Importance of Studying Food & Dairy Microbiology: Scope & history of food Microbiology, important microorganisms in Food Microbiology – Molds, Yeasts and Bacteria. Source of contamination (primary sources). Extrinsic and intrinsic factors influencing the microbial growth in food.

UNIT – II **(10 Hours)**

Fermented microbial food and food spoilage: Fermented foods – Bread, Sauer Kraut, pickles, Tempeh and Idli; Nutritive value of fermented foods. Spoilage of food by microorganisms- fruits and vegetables, meat and meat products, fish & other sea foods, poultry and egg.

UNIT – III **(10 Hours)**

Food preservation: Control of microorganisms in food; control of access; control by physical removal, control by heat – high and low temperature, reduced water activity, Preservatives and Class I & II preservatives, novel processing technology, combination of methods (Hurdle concept).

UNIT – IV **(10 Hours)**

Food borne illness and safety: Food borne pathogens - (a) Bacterial: *Staphylococcal, Clostridium, Escherichia, Salmonella* (b) Fungal: Mycotoxins, (c) Protozoa – Amoebiasis. Need for Food safety – Type of Food safety hazards – Indian & International Foods Laws – Food safety management system - HACCP, IFS, BRC, SQF, FSSC, ISO 22000:2005 & ISO 22002) – Food safety audits :– Audit reporting & communication.

UNIT – V **(10 Hours)**

Dairy Microbiology: Contamination, spoilage and preservation of milk and milk products. Fermented dairy products – Curd, butter milk, yoghurt, cheese. Pro and Prebiotics.

TEXT BOOK:

1. *Frazier, W.C. and Westhoff, D.C.* 2001. **Food Microbiology**. [Fourth Edition]. Tata Mc Graw-Hill Publishing Company Ltd., New Delhi.

REFERENCE BOOKS:

1. *James M Jay, Martin J Loessner and David A Golden.* 2005. **Modern Food Microbiology.** [Seventh Edition]. CBS Publishers & Distributors Ltd., New Delhi.
2. *Bibek Ray.* 2003. **Fundamentals of Food Microbiology**. [Third Edition]. CRC press, Washington DC, USA.

15PMBMP201	CORE PRACTICAL – II	SEMESTER - II

Immunology, Medical Microbiology, Microbial Taxonomy and Diversity and Food Microbiology

LIST OF EXPERIMENT

1. ABO Blood grouping – Rh typing and cross matching.
2. Agglutination tests – WIDAL, RA, ASO and CRP.
3. Collection and transportation of clinical specimens.
4. Isolation and Identification of bacteria causing urinary tract infection.
5. Isolation and Identification of bacterial pathogens causing throat infection.
6. Identification of unknown pathogen from pus from infected wound.
7. Identification of unknown pathogen from blood sample.
8. Identification of unknown pathogen from Diarrheic stool.
9. Most Probable Number (MPN) Test.
10. Reduction test for milk – Methylene blue reduction test.
11. Enumeration of micro organisms from spoiled food.
12. Microbiological examination of milk by standard plate count.

REFERENCE BOOKS:

1. *Mackie and McCarthy* 1994. **Medical Microbiology.** Volume I & II [Fourteenth edition], Churchill Livingston, USA.
2. *Aneja, K.R.,* 2002. **Experiments in Microbiology, plant pathology, tissue culture and mushroom culture production technology**. [Third edition]. New Age International Publishers (P) Ltd. New Delhi.

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

Total Hours: 38

OBJECTIVE:

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

CONTENTS

UNIT- I **(8 Hours)**

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

UNIT- II **(6 Hours)**

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

UNIT- III **(8 Hours)**

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

UNT- IV **(8 Hours)**

Clinical Chemistry and Enzymology: Diabetes Mellitus - Introduction, screening tests, diagnostic tests, insulin tolerance test. Estimation of glucose in blood, GTT, glycosylated haemoglobin. Cardiovascular disease - Estimation of cholesterol, urea, creatinine and protein. Enzymology - Alkaline and acid phosphatase.

UNIT- V **(8 Hours)**

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

TEXT BOOKS:

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

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

LIST OF EXPERIMENT

1. **Clinical haematology**

   Enumeration of WBC and RBC.

   Estimation of haemoglobin (Sahli's method).

   Erythrocyte sedimentation rate (Westergren's method).

2. **Blood analysis**

   Estimation of glucose in blood (Nelson Somogyi's method).

   Estimation of urea in blood (DAM method).

   Estimation of creatinine in blood (Jaffe's method).

3. **Urine analysis**

   Estimation of creatinine in urine (Jaffe's method).

   Qualitative analysis of normal and abnormal constituents in urine.

REFERENCE BOOK:

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

15PBTMBI201/ 15PBTBCI201	INTER DISCIPLINARY COURSE I: PLANT TISSUE CULTURE TECHNOLOGY	SEMESTER - II

Total Hours: 40

OBJECTIVE:

1. To understand the basic techniques in plant tissue culture.

CONTENTS

UNIT – I **(7 Hours)**

Introduction to Plant cells, Types of plant cells, Principles of plant tissue culture, Tissue culture media, Growth regulators and Sterilization techniques.

UNIT – II **(8 Hours)**

Callus and suspension culture, Micropropagation, Meristem culture, Somatic embryogenesis, Protoplast isolation, Fusion of protoplast, Somaclonal variations.

UNIT – III **(9 Hours)**

Agrobacterium mediated gene transfer; *Agrobacterium* based vectors, direct gene transfer methods - electroporation, microinjection, particle bombardment.

UNIT – IV **(10 Hours)**

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.

UNIT – V **(6 Hours)**

Secondary metabolites from plants – Alkaloids, flavonoids and phenolic compounds, Germplasm conservation.

TEXT BOOKS:

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

15PBTMBIP201/ 15PBTBCIP201	**INTER DISCIPLINARY COURSE PRACTICAL I: PLANT TISSUE CULTURE TECHNOLOGY**	**SEMESTER - II**

LIST OF EXPERIMENT

1. Media preparation
2. Hormone stock solution preparation
3. Callus induction
4. Micropropagation
5. Protoplast isolation

REFERENCE BOOKS:

1. *Aneja, K.R*. 2003. **Experiments in Microbiology, Plant pathology and Biotechnology.** [Fourth Edition]. New age international publishers (P) Ltd., New Delhi.

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

15PVE201	VALUE EDUCATION: HUMAN RIGHTS	SEMESTER- II

Total Hours: 25

OBJECTIVE:

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

CONTENTS

UNIT - I **(5 Hours)**

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

UNIT - II **(5 Hours)**

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

UNIT - III **(5 Hours)**

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

UNIT - IV **(5 Hours)**

Women's Rights: Right to Inheritance - Right to Marriage - Divorce and Remarry - Right to Adoption - Right to Education - Right to Employment and Career Advancement - Rights Relating to Dowry - Right for Equality - Right for Safe Working Conditions - Children's Rights - Right to Protection and Care - Right to Education - Issues Related with Infanticide - Street Children - Child Labour - Bonded

Labour - Refugees Rights - Minority Rights - Dalit Rights - Tribal Rights - Nomads Rights.

UNIT - V **(5 Hours)**

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

REFERENCE BOOK:

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

15PLS201	CAREER COMPETENCY SKILLS II	SEMESTER – II

Total Hours: 15

OBJECTIVE:

To enhance employability skills and to develop career competency

CONTENTS

UNIT – I **(3 Hours)**

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

UNIT – II **(3 Hours)**

Campus to Corporate-Effective Communication

UNIT – III **(3 Hours)**

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

UNIT – IV **(3 Hours)**

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

UNIT – V **(3 Hours)**

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

15PMBM301	CORE IX : GENETIC ENGINEERING	SEMESTER - III

Total Hours: 50

OBJECTIVES:

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

CONTENTS

UNIT – I **(10 Hours)**

Introduction to Genetic Engineering – Definitions, Historical perspectives. Enzymes in rDNA technology **-** Restriction enzymes – types – nomenclature – Properties of typeII restriction endonucleases. DNA ligase. DNA modifying enzymes – alkaline phosphatase & poly nucleotide kinase.

UNIT - II **(10 Hours)**

Cloning Vectors – Cloning vectors: Bacterial Plasmids- pBR322 & pUC vectors, Bacteriophages, λ, M13, Cosmids – Phasmids, Insertion vectors, replacement vectors. Yeast vectors- YEP, YRP, YCP & YAC. Shuttle vectors. Expression vector.

UNIT - III **(10 Hours)**

Cloning Strategies. Construction of genomic libraries. Gene transfer methods– transformation, electroporation, particle bombardment and microinjection. Screening and selection of clones.

UNIT - IV **(10 Hours)**

Transgenic animals: 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, T-DNA transfer, Ti plasmid derivatives- co-integrate vectors, binary vectors.

UNIT - V **(10 Hours)**

Techniques in rDNA technology – Blotting techniques – Southern, Northern and Western blotting. PCR amplification and its application. DNA sequencing methods – dideoxy, chemical and Next Generation Sequencing (NGS). Applications of Genetic Engineering in Medicine and Agriculture.

TEXT BOOKS:

1. *Brown, T.A*. 1995. **Gene Cloning – An Introduction**. [Third Edition]. Chapman and Hall, UK. **[Units I, II & III]**
2. *Old, R.M. and Primrose, S.B*. 1995. **Principles of Gene Manipulation**. [Sixth Edition]. Blackwell Scientific Publication, London. **[Units IV & V]**

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.

15PMBM302	CORE X : MOLECULAR BIOLOGY	SEMESTER - III

Total Hours: 50

OBJECTIVES:

1. To learn the basics of molecular biology.
2. To impose knowledge about genes and their regulation.

CONTENTS

UNIT - I **(10 Hours)**

Central dogma. DNA as genetic material-Griffith's experiment, Avery experiment, Hershey-Chase experiment. DNA replication- enzymology of DNA replication-Rolling circle replication, Messelson and Stahl experiment.

UNIT - II **(10 Hours)**

Transcription- the fundamentals of transcription, the basic mechanism of transcription, termination of transcription, temporal control of transcription. Translation - the genetic code - mechanism of translation. Post translational modification.

UNIT - III **(10 Hours)**

Gene regulation- General aspects of prokaryotic gene regulation - the *lac, trp, ara* and *Gal* operon. Eukaryotic gene regulation- regulatory strategies in Eukaryotes - gene alteration - regulation of synthesis of primary transcripts.

UNIT - III **(10 Hours)**

Bacteriophage – general properties and structure of phages. Stages in lytic life cycle - Lysogenic Life cycle - Prophage integration. Oncogenes and Tumor Suppressor Genes-Viral and cellular oncogenes, tumor suppressor genes from humans, Structure, function and mechanisms of action of pRB and p53 tumor suppressor proteins.

UNIT V **(10 Hours)**

Molecular Mapping of Genome-Genetic and physical maps, physical mapping and map based cloning, Southern and fluorescence in situ hybridization in genome analysis, RFLP, RAPD and AFLP analysis.

TEXT BOOKS:

1. *Prescott, L.M. Harley, J.P. and Klein, D.A* 2012. **Microbiology.** [Eighth Edition]. WMC. Brown Publishers. **[Unit I, III]**
2. *David Freifelder*. 1995. **Molecular Biology.** [Second Edition]. N.K. Mehra for Narosa Publishing House, New Delhi. **[Unit II, IV & V]**

REFERENCE BOOKS:

1. *Robert K Weaver* and *Philip W Hedrick.* **Genetics.** [Third Edition]. WMC.Brown Publisher. Singapore.
2. *Benjamin Lewin*. 2008. **Genes IX.** Jones and Bartlett Publishers. Singapore.

15PMBM303	CORE XI : INDUSTRIAL MICROBIOLOGY	SEMESTER – III

Total Hours: 50

OBJECTIVES:

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

CONTENTS

UNIT – I **(10 Hours)**

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.

UNIT – II **(10 Hours)**

Strain improvement – mutation – ionizing and non ionizing radiation – rDNA technology. Strain development technique – bacteria, fungi and yeast. Medium composition and medium sterilization – batch, continuous. Del factor.

UNIT – III **(10 Hours)**

Design of fermenter – 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.

UNIT – IV **(10 Hours)**

Instrumentation and control – Temperature, pH, Foam – its measurement and control. Downstream processing – criteria. Centrifugation – basket. Filteration – batch and continuous. Intracellular and extracellular recovery – solvent recovery and drying.

UNIT – V **(10 Hours)**

Effluent treatment – Disposal of waste – lagoons, spray irrigation, landfilling, incineration. Treatment process – physical, chemical and biological – trickle filters. Anaerobic treatment – anaerobic digestion and anaerobic filters.

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. **[Unit I, II & III]**
2. *Patel, A.H., 2005*. **An Introduction to Industrial Microbiology.** Macmillan India Ltd., Chennai. **[Unit IV & V]**

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. **[Unit II]**

15PMBM304	CORE XII : BIOINSTRUMENTATION	SEMESTER - III

Total Hours: 50

OBJECTIVES:

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

CONTENTS

UNIT – I **(10 Hours)**

Centrifugation: Principles of sedimentation, centrifugal force, Swedberg constant. Types of centrifuges – Desk top, High speed and Ultra Centrifuge. Methods of centrifugation and its applications – Differential, Density gradient.

UNIT – II **(10 Hours)**

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.

UNIT – III **(10 Hours)**

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.

UNIT – IV **(10 Hours)**

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 - principle and applications, MALDI-TOF.

UNIT – V **(10 Hours)**

Radioisotopes and Physicochemical Techniques: Radioactivity – Measurement - GM Counter, Autoradiography and Liquid Scintillation Counter. Physicochemical Techniques – PCR – Types of PCR – RT PCR; ELISA and Flow Cytometry.

TEXT BOOKS:

1. *Upadhyay, A. and Upadhyay, K.* 1998. **Biophysical Chemistry – Principles and Techniques.** [Third Edition]. Himalaya Publishing House, Mumbai. **[Unit IV]**
2. *Wilson, K. and Walker, J.* 2003. **Practical Biochemistry - Principles and Techniques.** [Sixth Edition]. Cambridge University Press, Cambridge, UK. **[Unit I, II, III & V]**

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.

15PMBEL301	ELECTIVE I: DIAGNOSTIC MICROBIOLOGY	SEMESTER -III

Total Hours: 50

OBJECTIVES:

1. To know the basics of clinical sample collection
2. To understand the principles of processing clinical sample collection.

CONTENTS

UNIT –I **(10 Hours)**

Collection and transport and Microbiological examination of specimens – Blood, Urine, Sputum, CSF, Pus & Stool.

UNIT –II **(10 Hours)**

Diagnostic methods in Mycology – Direct Microscopic examination, culture media and incubation, Serological tests for fungi – Antibiotic sensitivity test – well and disc diffusion. Antifungal susceptibility testing.

UNIT – III **(10 Hours)**

Diagnostic methods in basic Virology- Viral culture- Media and cells used – Specimen processing – isolation and identification of viruses. Serology of Hepatitis and HIV.

UNIT –IV **(10 Hours)**

Diagnostic methods for parasitic infections – Diagnostic techniques for faecal, gastrointestinal specimens. Identification of Intestinal Protozoa – Amoeba, Blood protozoa – Malaria, Intestinal Helminthes and Blood Helminthes.

UNIT –V **(10 Hours)**

Molecular Diagnostic methods- RFLP, RAPD, PCR and Blotting techniques in diagnosis. Molecular diagnosis of tuberculosis, malaria and AIDS.

TEXT BOOKS:

1. *Bailey and Scott's.* 1990. **Diagnostic Microbiology,** [Eighth edition]. The C.V. Mosby Company. **[Unit III & V]**
2. *Gerald Collee, J. Barie P. Marimon, Andrew, G. Fraser and Abthony Simmons.* 1996. Mackie & MacCartney **Practical Medical Microbiology**. [Fourth edition]. Churchill Livingstone Publishers. **[Unit I, II & V]**

REFERENCE BOOK:

1. *Monica Cheesbrough* (ELBS). **Medical laboratory manual for tropical countries. Volume II: Microbiology**. ELBS Publishers.

15PMBEL302	ELECTIVE II: AGRICULTURAL MICROBIOLOGY	SEMESTER - III

Total Hours: 50

OBJECTIVES:

1. To understand the types and role of microorganisms that survives in soil.
2. To ascertain the importance of biofertilizers and biocontrol agents and its application.

CONTENTS

UNIT – I **(10 Hours)**

Nature of soil - Formation, structure and properties of soil. Soil Microflora- Bacteria, Fungi, Actinomycetes, Algae, Protozoa and viruses. Factors affecting Soil Microorganisms. Methods of studying soil microorganisms.

UNIT – II **(10 Hours)**

Microbial decomposition: Cellulose, hemicelluloses, pectin, chitin. Bioconversion of organic wastes. Principles and application of composting and vermicomposting. Biological Nitrogen fixation – symbiotic and non symbiotic nitrogen fixation.

UNIT – III **(10 Hours)**

Biofertilizer and Biocontrol agents **–** *Rhizobium, Azotobacter, Cyanobacteria, Azolla* and Phosphate Solubilizing Bacteria (PSB), *Mycorrhizae*, *Trichoderma* and *Pseudomonas* – Mass multiplication and crop responses.

UNIT – IV **(10 Hours)**

Biopesticide – mode of action, formulation and application methods of Bacteria – *Bacillus thuringenesis;* Fungal - *Breuvaria bassiana* and Viral - *Nuclear polyhedrosis* and *Baculovirus*. Plant disease – causes, methods to study plant disease – spread of plant diseases and control measures.

UNIT – V **(10 Hours)**

Plant pathology – Bacterial disease – Blight of rice, Citrus canker, Scab of potato. Fungal disease – Rust of wheat, Blast of rice, Wilt of cotton, Red rot of sugarcane, Tikka leaf spot of groundnut. Viral diseases- Bunchy top of Banana, Tobacco mosaic. Mycoplasma disease – Little leaf of brinjal.

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. **[Unit I & II]**
2. *Martin Alexander.* 1997. **Introduction to Soil Microbiology**. John Wiley & Sons, New York, USA. **[Unit III]**
3. *Rangaswami. G. and A. Mahadvan.* 1999. **Diseases of crop plants in India.** Fourth edition. Prentice Hall of India Pvt Ltd., New Delhi. **[Unit IV & V]**

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. **[Unit IV & V]**.

15PMBMP301	CORE PRACTICAL – III	SEMESTER – III

Genetic Engineering, Molecular Biology, Industrial Microbiology, Bioinstrumentation

LIST OF EXPERIMENT

1. Isolation of Genomic DNA.
2. Isolation of Plasmid DNA.
3. Protein profiling – SDS-PAGE.
4. Polymerase Chain Reaction.
5. Isolation of mutants by replica plating and gradient plate technique.
6. Isolation of amylase producers from soil.
7. Isolation of antibiotic producers from soil.
8. Separation of aminoacids by TLC.
9. Separation of pigments by column chromatography.
10. Enzyme immobilization technique.
11. Estimation of Biological Oxygen Demand (BOD).
12. Estimation of Chemical Oxygen Demand (COD).

REFERENCE BOOK:

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

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

Total Hours: 36

OBJECTIVE:

To enable the students to learn about

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

CONTENTS

UNIT - I **(7 Hours)**

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

UNIT - II **(7 Hours)**

Distribution and elimination of drugs. Factors influencing drug distribution and elimination. Mechanism of drug action- Physical, Chemical, Enzymes, Receptors.

Drug-Receptor interactions: Receptor – Definition Agonist, partial aganoist and antagonist. Forces involved in drug-receptor interaction. Drug action not mediated through receptor. Dose response relationship (LD_{50} and ED_{50}).

UNIT - III **(7 Hours)**

Adverse drug reactions- Definition, Classification and drug induced side effects, biological effects of drug abuse and drug dependence, drug tolerance and intolerance.

Drug discovery- Animal toxicity studies and clinical evaluation Phase I-IV (Elementary details)

UNIT - IV **(7 Hours)**

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

UNIT - V **(8 Hours)**

Secondary metabolites of plants - Alkaloids, flavonoids and terpenoids, phenols – occurrence, distribution and functions. (Synthesis not required).

Extraction of Phytopharmaceuticals or crude drugs – (Aqueous, Methonol and Chloroform extracts) maceration, percolation and soxhlet extraction - Analysis of phytochemicals (carbohydrates, aminoacids, proteins, phenols, flavonoids, alkaloids tannins, glycosides, saponins and terpenoids).

TEXT BOOKS:

1. *Tripathi, K. D*. 1999. **Essentials of Medical Pharmacology.** [Fourth Edition]. Jaypee Brothers Medical Publishers, New Delhi **[UNIT I, II & III]**.

2. *Kokate, C. K., Purohit, A. P.* and *Gokhale, S.B.* 2007. **Pharmocognosy.** [Thirty Seventh Edition]. Nirali Prakasham, Pune. **[UNIT IV & V]**.

REFERENCE BOOKS:

1**.** *Satoskar, R. S., Nirmala N. Rege* and *Bhandarkar S.D,* 2011. **Pharmacology and Pharmacotherapeutics** [Twenty-Second edition]. Popoular Prakashan Pvt Ltd, Mumbai**.**

2**.** *Roseline, A.* 2011**. Pharmacognosy.** M.J.P Publishers, Chennai**.**

15PBCMBIP301/ 12PBCBTIP301	INTERDISCIPLINARY COURSE PRACTICAL II: PHARMACEUTICAL BIOCHEMISTRY	SEMESTER - III

LIST OF EXPERIMENT

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

REFERENCE BOOK:

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

15PBTMBI301/ 15PBTBCI301	INTER DISCIPLINARY COURSE II: ANIMAL TISSUE CULTURE TECHNOLOGY	SEMESTER - III

Total Hours: 40

OBJECTIVE:

1. To understand the basic techniques in Animal tissue culture.

CONTENTS

UNIT – I **(8 Hours)**

Introduction to Animal tissue culture, Applications of tissue culture, Designing the tissue culture laboratory – washing and sterilization area, Storage area and Tissue culture room, Equipments in tissue culture laboratory – Inverted Microscope, Centrifuge, Laminar flow benches, CO_2 incubator.

UNIT – II **(8 Hours)**

Glassware and other plastic ware in tissue culture – Substrate materials for growing cells, Tissue culture vessels. Tissue culture media – Properties and special requirements, Complete media, Conditioned media.

UNIT – III **(8 Hours)**

Type of tissue culture –Primary explant culture, Isolation of tissues and disaggregation methods, Cell culture, Organ culture.

UNIT – IV **(8 Hours)**

Cell culture **-** Transformation, Differentiation and Dedifferentiation, Growth curve of cells, Types of microbial contamination, Stem cell culture.

UNIT – V **(8 Hours)**

Applications of Animal cell culture technology – Somatic cell fusion, Transgenic fish and sheep.

TEXT BOOK:

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

REFERENCE BOOK:

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

15PBTMBIP301/ 15PBTBCIP301	INTER DISCIPLINARY COURSE PRACTICAL II: ANIMAL TISSUE CULTURE TECHNOLOGY	SEMESTER - III

LIST OF EXPERIMENT

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

REFERENCE BOOK:

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

15PMBM401	CORE XIII : BIOSTATISTICS AND RESEARCH METHODOLOGY	SEMESTER - IV

Total Hours : 50

OBJECTIVES:

1. To learn about the basics of biostatistics.
2. To familiarize the application of biostatistics in biology.
3. To know about the basics of research methodology.

CONTENTS

UNIT –I **(10 Hours)**

Biostatistics –Meaning, importance and usefulness, Variables –Scale and Measurements, Data –Primary data and secondary data –Methods of collecting primary data –sources of secondary data -Diagrammatic and graphical Representation of data - Measures-Mean, Standard deviation, Co-efficient of variation –Normal distribution-Properties and its importance.

UNIT-II **(10 Hours)**

Probability –Definition –Simple problems based on addition theorem and multiplication theorem and Bayes theorem. Correlation -Karl Pearson and rank correlation -Regression -Simple linear regression, Concept of partial and multiple correlations (Three variables only).

UNIT-III **(10Hours)**

Test of significance -Population, sample –Sampling Methods –Point estimation and interval estimation (Concept only) Hypothesis –Simple hypothesis –Standard error – t-test, chi-square test of independent of attributes, ANOVA -One way classification and two way classification and its interpretation. Introduction to Statistical software.

UNIT – IV **(10 Hours)**

Research – meaning, constrains. Steps in research process, formulation of hypothesis. Review of literature. Research design- Experimental – Simple types, component and Characteristics. Non-experimental designs – descriptive, correlational, comparative.

UNIT V **(10 Hours)**

Communication of Research findings – synopsis presentation, guidelines of structuring an article. Documentation of research report. Research readings. Various funding agencies in India.

TEXT BOOKS:

1. *Gupta, S.P.* **Statistical Methods**. 2006. Sultan Chand and Sons Publishers, New Delhi. **[Unit I, II & III]**
2. *Gurumani, K. 2000.* **Research Methodology in Biology**. New Age Publications. **[Unit IV & V]**

REFERENCE BOOKS:

1. *Zar, J.H.* 1993. **Biostatistics Analysis**. Prentice Hall, New Jersey.
2. *Daniel, J.* 1994. **Biostatistics.** A Foundation for Analysis in Health Science. [Sixth Edition]. John Wiley and Sons, New York.
3. *Baruch A Brody* and *Tristram Engelhardt H.* 1987. **Bioethics**: **Readings and Cases.** Pearson education, UK.
4. *Satheesh, M.K.* 2008. **Bioethics and Biosafety**. IK International Pvt. Ltd., New Delhi.

15PMBM402	CORE XIV: BIOINFORMATICS, BIOETHICS AND INTELLECTUAL PROPERTY RIGHTS	SEMESTER - IV

Total Hours : 50

OBJECTIVES:

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

CONTENTS

UNIT I **(10 Hours)**

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.

UNIT II **(10 Hours)**

Sequence analysis – Local Alignment, Global alignment- BLAST, Multiple sequence alignment-ClustalW, Phylogenetic analysis- WPGMA, UPGMA methods. Human Genome Project.

UNIT III **(10 Hours)**

Secondary structure prediction – GOR, Chau-Fasman method, ORF finder, restriction site analysis, molecular visualization tool-Rasmol. Molecular Docking.

UNIT IV **(10 Hours)**

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.

UNIT V **(10 Hours)**

Biosafety - 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.

TEXT BOOKS:

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

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.

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

S.NO.	SUBJECT CODE	SUBJECT	SEMESTER	OFFERED TO THE STUDENTS OF
1.	15PMBBCI201/ 15PMBBTI201	IDC I : Fundamentals of Microbiology And Clinical Microbiology	II	M.Sc Biochemistry/ M.Sc Biotechnology
	15PMBBCIP201/ 15PMBBTIP201	IDC Practical I: Fundamentals of Microbiology And Clinical Microbiology		M.Sc Biochemistry/ M.Sc Biotechnology
2.	15PMBBCI301/ 15PMBBTI301	IDC II: Industrial Microbiology	III	M.Sc Biochemistry/ M.Sc Biotechnology
	15PMBBCIP301/ 15PMBBTIP301	IDC Practical II: Industrial Microbiology		M.Sc Biochemistry/ M.Sc Biotechnology