ST. JOSEPH'S COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)
(Affiliated to Thiruvalluvar University, Vellore)
CUDDALORE-1

PG & RESEARCH DEPARTMENT OF MICROBIOLOGY

M.Sc. APPLIED MICROBIOLOGY

(ACADEMIC YEAR 2019-2020)

CURRICULUM TEMPLATE, SYLLABUS AND QUESTION PAPER PATTERN

M.Sc. APPLIED MICROBIOLOGY

Course of study and Scheme of Examinations (2015 – 2016 onwards)

SEME -STER	SUBJECT	PAPER	SUBJECT CODE	HOURS/ CREDITS	EXAM HOURS	MAX. MARKS
I	Core I	Principles of microbiology	PMB701S	5/4	3	100
	Core II	Immunology and Immunotechnology	PMB702S	5/4	3	100
	Core III	Molecular Biology & Microbial Genetics	PMB703S	5/4	3	100
	Core IV	Environmental Microbiology	PMB704S	5/4	3	100
	Elective I A	Methods In Biology	EPMB705T	2/2	3	100
	Elective I B	Bioseparation Techniques				
	Practical I	Lab course I	PMBP101	8/4	18 hrs (6 hrs X 3 days)	100
	Total for Semester I			*30/22*		
II	Core V	Food and Agricultural Microbiology	PMB806S	5/4	3	100
	Core VI	Fermentation Technology	PMB807S	5/4	3	100
	Core VII	Clinical Microbiology	PM808S	5/4	3	100
	Core VIII	Biotechnology	PMB809S	5/4	3	100
	Elective II A	Research Methodology	EPMB810T	2/2	3	100
	Elective II B	Intellectual Property Rights				
	Practical II	Lab course II	PMBP202	8/4	18 hrs (6 hrs X 3 days)	100
	Total for Semester II			*30/22*		

III	Elective III	Option 1: Biostatistics	EPMB911T	5/4	3	100
		Option 2: Biophysics				
	Core IX	Microbial Gene Technology	PMB912S	5/4	3	100
	Core X	Microbial Technology	PMB913S	5/4	3	100
	Core XI	Bioinformatics	PMB914	5/4	3	100
	Elective III	Human rights	ECHR901S	2/1	3	100
	Practical III	Lab course III	PMBP303	8/4	18 hrs (6 hrs X 3 days)	100
	Total for Semester III			*30/21*		
IV	Core XII	Genetic Engineering	PMB1015S	5/4	3	100
	Elective IV A	Biotechniques	EPMB1016S	2/2	3	100
	Elective IV B	Molecular Techniques				
		Project	JPMB1017	23/19	-	100
	Total for Semester IV			30/25		
	Grand Total			*120/90*		

YEAR – I	PRINCIPLES OF MICROBIOLOGY (For those students who are admitted in the year 2015 – 2016 onwards)	PMB701S
SEMESTER - I		HRS/WK - 5
CORE - 1		CREDIT - 4

Objective:

To make the students understand the basic principles of microbiology and physiology of microorganisms.

Unit - 1: **(15 Hrs)**

Scope of Microbiology - History - Microscopy - types - Visualization of cells and subcellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freeze-fracture methods for EM, image processing methods in microscopy - Stains and dyes – staining methods - Structure of bacterial cell - Structure and functions of cell organelles

Unit - 2: **(15 Hrs)**

Classification - Haeckel's, Whitaker's - Evolution of microorganisms - Outline of bacterial classification according to Bergey's manual – Polyphasic taxonomy – 16s rRNA gene based phylogeny – Mol % G+C analysis – Chemotaxonomic markers – fatty acid methyl esters, peptidoglycans – Conventional and molecular methods of studying microbial diversity

Unit - 3: **(15 Hrs)**

Fungi – characteristics, morphology, reproduction, physiology, classification – Lichens – Algae - occurrence, importance, characteristics, classification – Protozoa - occurrence, free-living, symbiotic, morphology, reproduction, classification – Viruses - general characteristics, morphology, multiplication – cultivation - classification – viruses of bacteria, plants, animals, human beings – Viroids, Prions - Rumen Microbiology

Unit - 4: **(15 Hrs)**

Nutritional requirements of microorganisms - Growth factors - Nutritional types -Culture media - Sterilization - Physical agents - High temperature, Low temperature, Desiccation, Osmotic pressure, Radiation, Filtration - Chemical agents - Phenols and phenolic compounds, Alcohols, Halogens, Heavy metals and their compounds, Dyes, Synthetic detergents, Quaternary ammonium compounds, Aldehydes, Gaseous agents - Antibiotics - Classification, Mode of action – Antifungal and antiviral agents - Microbial growth – Growth curve - Measurement of microbial growth – Batch and Continuous culture - Synchronous growth - Sporulation - Bacterial reproduction - Uptake of nutrients – Simple, Passive, Facilitated diffusion, Active transport, Group translocation

Unit - 5: **(15 Hrs)**

Principles of energetics – oxidation-reduction reactions – respiratory chain – Energy production by anaerobic process (Glycolysis, Pentose phosphate pathway, ED Pathway, Fermentation) - Energy production by aerobic process (TCA, catabolism of lipids, catabolism of proteins, respiration without oxygen, heterotrophic CO_2 fixation, glyoxylate cycle) Energy production by photosynthesis (cyclic, non-cyclic) - Mechanism of ATP synthesis – Bioluminescence

Text Books

- Prescott, L. M., J. P. Harely and D. A. Klain, Microbiology, 2003 (5th Edition) McGraw Hill, New York.
- Atlas R. A. Principles of Microbiology (2nd Edition), 1997. Wm. C. Brown Publishers, Iowa.

Reference Books

- Salle A. J., Fundamental Principles of Bacteriology, 1974 (TMH Edition), Tata McGraw Hill Publishing Company, New Delhi.
- Moat, A.G. and J. W. Foster. Microbial Physiology, III Edition. Wiley - LISS, A John Wiley & sons. Inc. Publications, 1995.
- Caldwell, D.R., 1995. Microbial Physiology & metabolism, USA.Wm.C. Brown Communications, Inc.
- Dawes, I. W. and Sutherland L.W. I992. Microbial Physiology, (2nd Edition), Oxford Blackwell Scientific Publications.

YEAR – I	IMMUNOLOGY AND IMMUNOTECHNOLOGY (For those students who are admitted in the year 2015 – 2016 onwards)	PMB702S
SEMESTER - I		HRS/WK - 5
CORE - 2		CREDIT - 4

Objective:
To make the students completely equipped with techniques in serology.

Unit - 1: **(15 Hrs)**
History of Immunology – Overview of the immune system - Cells and organs of the immune system - Antigens - types, property, haptens, adjuvants, vaccines -Immunoglobulins - structure & classes

Unit - 2: **(15 Hrs)**
Immunohaemotology - Blood groups, blood transfusion, Rh incompatibilities - Antigen-Antibody reactions - Agglutination, Precipitation, Complement fixation, Immunofluorescence, ELISA, RIA

Unit - 3: **(15 Hrs)**
Host-Parasitic relationships - Microbial infections - Virulence and host resistance - Innate and acquired immunity – vaccines – Definitions & Types - Brief account of MHC molecules – Antigen processing and presentation – T-cell receptors – T-cell maturation, activation and differentiation – B-cell generation, activation and differentiation - Cell mediated Immunity – Lymphokines and Cytokinins

Unit - 4: **(15 Hrs)**
Complement pathways - Classical and Alternate pathways - Hypersensitivity -Type I, II, III and IV - Basic concepts of Autoimmunity – Brief account of autoimmune diseases – Immunodeficiency – Transplantation immunology – immunological basis of graft rejection, Immunosuppressive therapy - Cancer and the immune system – oncogenes, tumors of the immune system, tumor antigens, immune response to tumors, cancer immunotherapy

Unit - 5: **(15 Hrs)**
Antibody production - Production of antisera – Haemagglutination titre and assay for antibody secreting cells – Separation and Identification of protein or antigen – Hybridoma technology: Monoclonal antibodies – Antibody engineering – Gene transfer technology – SCID Mice and SCID – human mice – Bone marrow transplantation – Tissue culture – Other techniques contributing to immunotechnology

Text Books
Goldsby, R.A., T. J. Kindt and B. A. Osborne, Kuby Immunology, 2000 (4th Edition) W. H. Freeman and Company, New York.

Reference Books

- Roitt, I. M. Essential Immunology, (8th Edition), Blackwell Science.
- Mark Peakman and DiegoVergani. 1st magazine, 1997, Basic and Clinical Immunology. Churchill Livingstone, New York.
- Tizard, I. R. Immunology. 1995 (4lh Edition), Saunders College Publishing.

YEAR – I	MOLECULAR BIOLOGY AND MICROBIAL GENETICS (For those students who are admitted in the year 2015 – 2016 onwards)	PMB703S
SEMESTER - I		HRS/WK - 5
CORE - 3		CREDIT - 4

Objective:
To make the students familiar with basics and application of molecular biology and microbial genetics.

Unit - 1: **(15 Hrs)**

Nucleic Acids – Components of Nucleic acids – The double helix – Denaturation and melting curves – Renaturation – Circular and superhelical DNA – RNA – types and structure - Nucleases – Methods used to study macromolecules – isolation of nucleic acids – determination of the base sequence of DNA - Chemical and Physical structure of a polypeptide chain.

Unit - 2: **(15 Hrs)**

DNA replication – the basic rule for replication of all nucleic acid – the geometry of DNA replication – Enzymology of DNA replication – Discontinuous replication – Bidirectional replication – Rolling replication – **DNA damage and repair** – Biological indications of damage to DNA. Biological Indication of Repair – biochemical mechanisms for repair of thymine - **Mutations and Mutants** – Isolation of mutants – Genetic analysis of mutants – Mutagenesis – Reversion – Suppression – **Plasmids** - Types – Detection of plasmids – purification of plasmid DNA – Transfer of plasmid DNA – Plasmid replication – Partitioning of plasmid replicas at cell division – properties of particular bacterial plasmids.

Unit - 3: **(15 Hrs)**

Transposable elements – Insertion sequences – detection of transposition in bacteria – types of bacterial transposons – Transpostion - **Gene expression** – Transcription – messenger RNA – Translation – the genetic code – overlapping genes – polypeptide synthesis – complex translation units - Regulation of gene expression – common modes of regulation – the E. coli Lactose system and the operon model – the tryptophan operon, a biosynthetic system. Autoregulation

Unit - 4: **(15 Hrs)**

Bacterial Transformation – the discovery of transformation, detection of transformation – competence – DNA uptake – molecular mechanism of transformation – mapping by transformation. - **Bacterial Conjugation** – Hfr Transfer, Recombination in recipient cells – properties of systems lacking recombination proteins – the RecA, B, C proteins and their function – chromosome transfer in bacteria other than E. coli

Unit - 5: **(15 Hrs)**

Bacteriophages – General properties life cycle – counting phage – properties of a phage-infected bacterial culture – specificity in phage infection. Host restriction and modification - **Phage genetics I**: phage T4 – Phage mutants, Genetic mapping of phage T4, features of the T4 life cycle. **Phage genetics II**: phage λ – λ DNA and its gene organization, outline of the life cycle of λ, λ DNA replication and phage production, recombination in the λ life cycle. **Phage genetics III**: Lysogeny – Immunity and repression – lysogenization and prophage insertion – prophage excision – Polylysogeny. **Phage genetics IV**: Transduction – DNA transfer by means of transduction – cotransduction and linkage – properties of specialized transducing prarticles.

Textbooks

Freifelder, D., Microbial Genetics. 1987, Narosa Publishing House, New Delhi.

Reference Books

- Benjamin Lewin, Gene VIII, 2003 (8th Edition) Oxford University Press.
- Twyman, R M., Advanced Molecular Biology – A concise Reference, 1998, Viva Books Private Ltd., New Delhi.
- Streips, U. N. and R. E. Yasbin, Modern Microbial Genetics, 2002 (2nd Edition), Wiley-Liss, Inc., New York.

YEAR – I	ENVIRONMENTAL MICROBIOLOGY (For those students who are admitted in the year 2015 – 2016 onwards)	PMB704S
SEMESTER - I		HRS/WK - 5
CORE - 4		CREDIT - 4

Objective:

To make the students understand the importance of microbes in ecology and bioremediation.

Unit - 1: **(15 Hrs)**

Microbiology of air - droplet nuclei, aerosols - enumeration of microorganisms in air- air sanitation - Laboratory hazards - airborne diseases - Aquatic microflora - lakes, ponds, rivers, ocean, estuary, ground water -significance – study of aquatic microflora – Eutrophication - Waterborne diseases

Unit - 2: **(15 Hrs)**

Waste water treatment - primary, secondary (anaerobic and aerobic - trickling, activated sludge, oxidation pond) - Sludge digestion - Disposal - Drinking water treatment - chlorination - Microbiological standards of water - Water pollution - indicators of water pollution - BOD – COD - techniques for the study of water pollution

Unit - 3: **(15 Hrs)**

Role of microbes in soil fertility - methods used in soil microbiology – Deep subsurface Microbiology - Biodegradation of pesticides and pollutants in soil - Biogeochemical cycles - carbon, phosphorus, sulfur, iron, and nitrogen cycles – Green house effect and microorganisms

Unit - 4: **(15 Hrs)**

Interaction among microbial populations (Neutralism, commensalism, synergism, Mutualism, competition, parasitism, antagonism) – Microbial interaction with plants – rhizosphere, mycorrhizae, phyllosphere, nitrogen fixation - Microbial interaction with animals – microbial contribution to animal nutrition – symbiotic relationship

Unit - 5: **(15 Hrs)**

Bioleaching – recovery of metals – bioaccumulation of metals - acid-mine drainage - Biodeterioration – biofouling – Biofilms – Composting – Quantitative microbial ecology – sample collection, detection of microbial populations, determination of microbial numbers and biomass

Textbooks

- Atlas & Bartha, Microbial Ecology - Fundamental and Applications, 1998, Benjamin/ Curmmings Publishing Company, Inc., California
- Joseph C. Daniel. Environmental Aspects of Microbiology, 1996, Brightsun Publications, Chennai.

Reference Books

- Mitchell, R (ed) Environmental Microbiologv. 1992, John Wiley, New York.
- Grant W. D. and Long P.E., Environmental Microbiology, 1981 Blackie and Son Ltd,, Glasgow

YEAR – I	METHODS IN BIOLOGY (For those students who are admitted in the year 2015 – 2016 onwards)	EPMB705T
SEMESTER - I		HRS/WK - 2
ELECTIVE – I A		CREDIT - 1

Objective:
To make the students familiar with techniques routinely used in bio sciences

Unit 1: **(6 Hrs)**
Biophysical methods: Analysis of biomolecules using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy

Unit 2: **(6 Hrs)**
Biophysical methods: structure determination using X-ray diffraction and NMR; analysis using light scattering, different types of mass spectrometry and surface plasma resonance methods

Unit 3: **(6 Hrs)**
Radiolabeling techniques: Properties of different types of radioisotopes normally used in biology, their detection and measurement; incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material, safety guidelines

Unit 4: **(6 Hrs)**
Electrophysiological methods: Single neuron recording, patch-clamp recording, ECG, Brain activity recording, lesion and stimulation of brain, pharmacological testing, PET, MRI, fMRI, CAT

Unit 5: **(6 Hrs)**
Methods in field biology: Methods of estimating population density of animals and plants, ranging patterns through direct, indirect and remote observations, sampling methods in the study of behavior, habitat characterization-ground and remote sensing methods.

Textbooks

- Boyer, R. Modern Experimental Biochemistry (3rd Edition) 2000. Addison Wesley Longman.
- Upadhyay, Upadhyay and Nath, Biophysical Chemistry Principles and Techniques, Himalaya Publications, 1997.

Reference Books

- Wilson and Walker, A Biologists guide to Principles and Techniques of Practical Biochemistry (5th Edition) 2000 Cambridge University Press.
- David Freifelder, Physical Biochemistry, (2nd Edition) 1982, W. H. Freeman and Company, New York.

YEAR – I	BIOSEPARATION TECHNIQUES (For those students who are admitted in the year 2015 – 2016 onwards)	
SEMESTER - I		HRS/WK - 2
ELECTIVE – I B		CREDIT - 1

Objective:
To learn the fundamentals of bioseparation techniques, importance, and its need.

UNIT 1 **(6Hrs)**
PRIMARY SEPARATION TECHNIQUES: Adsorption, xtraction,precipitation,distillation **, f**iltration and solvent evaporation, Crystallization, Freeze drying. Reverse Miscellar , mechanism extraction methods.

UNIT-2 **(6Hrs)**
CELL DISRUPTION METHODS: Physical, chemical, mechanical methods- Thermolysis, Osmosis,Ultrasonication, alkali treatment, Detergent solubilization.Cell wall permeabilization, Enzyme digestion,bead mill disruption,High pressure homogenizer.

UNIT-3 **(6Hrs)**
MEMBRANE TECHNOLOGY: Classification of membranes, Principle &applications .Nanofiltration,Ultrafiltration,Microfiltration. Reverse Osmosis –Process, Principle.

UNIT-4 **(6Hrs)**
ADVANCED CHROMATOGRAPHY - Gel Exclusion Chromatography – High Performance Liquid Chromatography (HPLC) – Gas Chromatography – LC Mass Spectrometry. Fast performance liquid chromatography.(FPLC).

UNIT-5 **(6Hrs)**
SEPARATION METHODS - Immonomagnetic separation, Ultrasonication, DirectEpiflouresent filter technique, Hydrophobic grid membrane filter technique.

TEXT BOOKS:

- Rodney Boyer, Modern Experimental Biochemistry (3rd Edition) 2000. Addison Wesley Longman, Inc.
- Upadhyay, Upadhyay and Nath, Biophysical Chemistry Principles and Techiques, Himalaya Publications, 1997.

REFERENCE BOOKS:

- Wilson and Walker,A Biolgists guide to Principles and Techniques of Practical Biochemistry (5th Edition) 2000 Cambridge University Press.
- David Freifelder, Physical Biochemistry, (2nd Edition) 1982, W. H. Freeman and Company, New York.
- Ralph. Rapley . John .M.Walker ., Molecular Biomethods. Hand book. Human Press.Totowa. New Jersey.

CLASS: I M.Sc. APPLIED MICROBIOLOGY

SUBJECT: LAB COURSE – I **SEMESTER: I**

SUB: CODE: PMBP101S

EXPERIMENTS IN BASIC MICROBIOLOGY:

1. Gram staining
2. Negative staining
3. Capsule staining
4. Spore staining
5. Hanging drop technique
6. Micrometry
7. Direct microscopic count
8. Catalase test
9. Oxidase test
10. Indole test
11. Methyl red test
12. Voges proskauer test
13. Citrate utilization test
14. Urease test
15. Triple sugar iron agar test
16. Lysine iron agar test
17. Nitrate reduction test
18. Starch hydrolysis test
19. Casein hydrolysis test
20. Lipid hydrolysis test
21. Slide culture for fungi

EXPERIMENTS IN BASIC IMMUNOLOGY:

1. Separation of serum
2. Separation of plasma
3. ABO blood grouping by reverse grouping
4. ASO semi quantitative test
5. Single radial immunodiffusion
6. Double immuno diffusion
7. Rocket immuno electrophoresis
8. Serum electrophoresis
9. Isolation of lymphocytes
10. Dot ELISA

EXPERIMENTS IN BASIC ENVIRONMENTAL MICROBIOLOGY

1. Enumeration of total coliform by MPN method
2. Enumeration of faecal coliform by MPN method
3. Membrane filter technique
4. Biochemical oxygen demand
5. Nitrogen cycle:
   a. Ammonification
   b. Nitrification
   c. Denitrification

YEAR – I	FOOD AND AGRICULTURAL MICROBIOLOGY (For those students who are admitted in the year 2015 – 2016 onwards)	PMB806S
SEMESTER - II		HRS/WK - 5
CORE - 5		CREDIT - 4

Objective:
To make the students understand the importance of microbiology in the field of agriculture and food industry.

Unit - 1: **(15 Hrs)**
Importance of studying food and dairy microbiology - Microorganisms important in food microbiology - Food as a substrate for microorganisms – Factors affecting the kinds and number of microorganisms in food - Contamination and spoilage - Food preservation methods with principles physical irradiation, drying, heat processing - high temperature - low temperature - chilling, freezing, high pressure, modification of atmosphere - food additives – chemical sodium chloride, sugar, vinegar, class I and class II preservatives

Unit - 2: **(15 Hrs)**
Food fermentations – therapeutic and nutritional value of fermented foods - Milk and milk products - fermented dairy products - butter, cheese, yogurt, acidophilus milk - Spoilage and defects of fermented dairy products - Milk-borne infection, intoxication - Milk preservation methods – pasteurization, sterilization

Unit - 3: **(15 Hrs)**
Food poisoning and food borne infections by bacteria such as Brucella, Bacillus, Clostridium, Escherichia, Salmonella, Shigella, Staphylococcus, Vibrio, fungi and viruses; bacterial and fungal exo- and endo- toxins - Food borne disease outbreaks - laboratory testing - preventing measures - Food sanitation – Plant sanitation - quality control – HACCP - Food control agencies and its regulations

Unit - 4: **(15 Hrs)**
Plant pathogenic microorganisms – Microbial Diseases of plants - disease symptoms, - mode of entry of pathogens – Plant disease resistance – factors affecting disease incidence - control measures

Unit - 5: **(15 Hrs)**
Plant Diseases – Examples -Bacterial Diseases: Bacterial Blight of Paddy, Citrus Canker - Mycoplasma Diseases: Rice Yellow Dwarf, Fungal Diseases: Late Blight of Potato, Downy Mildew of Maize, Rust of Wheat, Wilt of Cotton, Leaf Spot of Turmeric, Blast disease of Rice, Mango Anthracnose - Viral Diseases: Leaf Curl of Tomato, Yellow Vein Mosaic of Bhendi – Nematode Diseases: Ear – Cockle of Wheat.

Text Books

- Frazier W. C. and D.C, Westhoff, Food Microbiology, 1988 (4lh Edition), Tata McGraw Hill Publishing Company Ltd.., New Delhi.
- G. Rangaswami, A. Mahadevan. Diseases of crop plants in India 4th Edition. 1999, Prentice - Hall of India Private Ltd., New Delhi.

Reference Books

- Doyle, M. P., L. R. Beuchat and T. J. Montville. Food Microbiology -Fundamentals and Frontiers, 2001 (2nd Edition), ASM Press. Washington, D.C.
- G. Rangaswami, D. J Bagyaraj, Agricultural Microbiology 2nd Edition,1998, Prentice - Hall of India Private Ltd., New Dethi.

YEAR – I	FERMENTATION TECHNOLOGY (For those students who are admitted in the year 2015 – 2016 onwards)	PMB807S
SEMESTER - II		HRS/WK - 5
CORE - 6		CREDIT - 4

Objective:

- To make the students familiar with microbiological techniques in fermentation industry.
- To make the students understand the application of microbes in fermentation industry.

Unit - 1: (15 Hrs)

Historical development of bioprocess technology, outline of an integrated bioprocess and the various (upstream and downstream) unit operations involved in bioprocesses, generalized process flow sheets - General requirements of fermentation processes, Basic design and construction of fermentor and ancillaries, Main parameters to be monitored and controlled in fermentation processes - asepsis and containment requirements - body construction and temperature control - aeration and agitation systems - **sterilization of fermenter**; Design of sterilization equipment - aseptic inoculation methods - sampling methods, valve systems - monitoring and control devices and types of fermenters - An overview of aerobic and anaerobic fermentation processes and their application in the biotechnology industry, solid-substrate fermentation and its applications.

Unit - 2: (15 Hrs)

screening and strain development strategies – preservation of industrially important microorganisms - Fermentation media - Desired qualities - Medium requirements for fermentation processes, Carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements, media formulation strategies - formulation of optimal growth and product formation, examples of simple and complex media - role of buffers, precursors, inhibitors, inducers and antifoams - design and usage of various commercial media for industrial fermentations, heat, sterilization of liquid media - thermal death kinetics of microorganisms - filter sterilization of liquid media, Air.

Unit - 3: (15 Hrs)

Downstream process - Objectives and criteria - foam separation - precipitation methods - filtration devices and filter aids - industrial scale centrifugation and cell disruption methods - liquid-liquid extraction - solvent recovery – chromatography - two-phase aqueous extraction - super-critical fluid extraction - ultrafiltration, drying devices, crystallisation and whole broth processing- Fermentation economics

Unit – 4: **(15 Hrs)**

Stoichiometry of Cell growth and product formation, degrees of reduction of substrate and biomass, yield coefficients of biomass and product formation, oxygen consumption and heat evolution in aerobic cultures, thermodynamic efficiency of growth - Phases of cell growth in batch cultures, product formation kinetics, substrate and product inhibition on cell growth and product formation.

Unit – 5: **(15 Hrs)**

Important industrial fermentations - production of enzymes (amylase, pectinases, cellulase) - Amino acid production (glutamic acid and lysine) - Production of antibiotics (penicillin, tetracycline) - Production of Vitamins (riboflavin, cyanocobalamin) - Production of alcohol (Ethanol) and beverages (beer and wine) - Organic acids - lactic acid, citric acid - Steroid transformations - Production of Vaccines, toxoids, antitoxin

Text Books

- Stanbury. P.F., A.Whitaker and S.J. Hall, Principles of fermentation Technology, 1995 (2nd Edition), Butterworth - Heinemann (Pergamon), Oxford.
- Crueger W. and A Crueger. Biotechnology, 2000 (2nd Edition), Panima Publishing Corporation, New Delhi.

Reference Book

- Waits, M.J., N.L. Morgan and G, Higton. Industrial Microbiology; An Introduction, 2001, Blackwell Science, Oxford.
- Reed, G, Prescott & Dunn's Industrial Microbiology, 1982 (4lh Edition), CBS Publishers Distributors, Delhi.

YEAR – I	CLINICAL MICROBIOLOGY (For those students who are admitted in the year 2015 – 2016 onwards)	PMB808S
SEMESTER - II		HRS/WK - 5
CORE - 7		CREDIT - 4

Objective:
To make the students familiar with clinical manifestations and diagnosis of various microbial infections.

Unit - 1: **(15 Hrs)**
Background to infectious diseases – Host-parasite relationship – Types of transmission – Specimen collection - Specimen quality – Diagnosis of infection – Processing of clinical specimens (Urine, faeces, sputum, pus).

Unit - 2: **(15 Hrs)**
Clinical manifestations and diagnosis of infections by body system – Upper respiratory tract infections – Infections of the eye – Lower respiratory tract infections – Urinary tract infections – Sexually transmitted diseases.

Unit - 3: **(15 Hrs)**
Gastrointestinal tract infections – Obsteric and perinatal infections – Central nervous system infections – Infections of the skin, muscle, joints, bone and hemopoietic system.

Unit - 4: **(15 Hrs)**
World wide virus infections (Measles, Mumps, Rubella, Cytomegalovirus infection, EBV infection, other human herpes virus infections and small pox) – Vector borne infections (Rickettsial diseases, Malaria, Dengue as examples) – Multisystem Zoonoses – Pyrexia of unknown origin – Infections in the compromised host.

Unit - 5: **(15 Hrs)**
Epidemiologic aspects of the control of infection and disease – Hospital acquired infection, sterilization and disinfection - Nucleic acid techniques in Diagnostic Microbiology.

Text Books

- Ananthanarayanan, R and C.K.J. Panicker. Text Book of Microbiology, 2000 (6lh Edition), Orient Longman Private Ltd., Chennai.
- Mims, C.A., Mims' Pathogenesis of Infectious Diseases. 1995 (4th Edition), Academic Press, London.

Reference Books

- Brooks, G.F., Janet S. Butel, Stephen A, Jawetz, Melnick & Adlerberg's Medical Microbiology, 21st Edition, Prentice Hall International Inc. 1998.
- Murray. P.R., G.S, Kobyashi, M.A. Pfaller and K. S. Rosenthal, Medical Microbiology, 1993, (2nd Edition), Mosby St. Louis.
- Betty A. Forbes, Daniel F. Sahm and Alice S. Weissfeld. Bailey & Scott's Diagnostic Microbiology, 2007 (12th Edition), Elsevier/ Mosby.

YEAR – I	BIOTECHNOLOGY (For those students who are admitted in the year 2015 – 2016 onwards)	PMB809S
SEMESTER - II		HRS/WK - 5
CORE - 8		CREDIT - 4

Objective:
To make the students familiar with the scopes and applications of biotechnology.

Unit - 1: **(15 Hrs)**
History, Scope and Definitions of Biotechnology – **Industrial Biotechnology** – Enzyme technology - Enzyme immobilisation, Products, Applications - Biotechnological potentials of Seaweeds, Microalgae – Single cell protein – Mushroom - Spirulina cultivation - Biotransformation

Unit - 2: **(15 Hrs)**
Plant Biotechnology - Plant tissue culture – callus culture – cell culture – protoplast culture – Somatic hybridization – Production of haploid plants – Somoclonal variations – Micropropagation – germ plasm conservation – Cryopreservation

Unit - 3: **(15 Hrs)**
Animal Biotechnology – animal cell culture – facilities and applications – culture media for animal cells – biology of cultured cells – primary culture and cell lines – scale-up – cell viability and cytotoxicity – cell transformation and cell cloning – organ and histotypic cultures – tissue engineering - Biohazards

Unit - 4: **(15 Hrs)**
Environmental Biotechnology – Biotechnological methods for environmental monitoring – Recalcitrant xenobiotics - Biodegradation (hydrocarbons, pesticides, herbicides) – Bioremediation – contaminated soils – marine oil pollutants - Biofuel - Production of Hydrogen gas as fuel from Microorganisms

Unit - 5: **(15 Hrs)**
Biotechnology and Society – Benefits of Biotechnology – Ethical, legal and social issues of Biotechnology – Patents - GATT and IPR – WIPO - History of Indian Patent System, Patent Administration in India - Patentable subject, Patents filing - Geographical indications – Bioethics – Peoples perception about Genetically modified products, GM foods, Genetically engineered organisms, release of GM into the environment – Ethical issues associated with cloning, genome sequencing, stem cell research

Text Books

- Gupta, P.K., Elements of Biotechnology, 1996. Rastogi and company, Meerut.
- Satyanarayana, U. Biotechnology. 2005. Books and Allied (P) Ltd., Kolkata

Reference Books

- Balasubramanian, D., C.F.A. Brycee., K. Dharmalingam, J. Green and K. Jayaraman, Concepts in biotechnology, 1996. Universities Press (India) limited, Hyderabad.
- Glick, B.R. and J.J. Pasternack, Molecular Biotechnology. 2002. Panima Publishing Corporation, New Delhi, Bangalore, Indian Edition.

YEAR – I	RESEARCH METHODOLOGY (For those students who are admitted in the year 2015 – 2016 onwards)	EPMB810T
SEMESTER - II		HRS/WK - 2
Elective – II A		CREDIT – 1

Objective:
To make the students understand the concept behind designing the research, data collection and data analysis using statistical methods.

Unit 1: **(6 Hrs)**
Research – Definition – Experimental designs - Identification, Selection and formulation of research problem – Research questions – Research Hypothesis

Unit 2: **(6 Hrs)**
Literature Collection – Literature Citation - Major search engines - Major Websites, book and scientific information – Journals – Impact factor

Unit 3: **(6 Hrs)**
Research Report – Components of a Research Report – Authors and Addresses – Abstract – Synopsis – Key words – Introduction – Materials and Methods – Results – Discussion – Acknowledgements – Summary and Conclusions – Appendixes – References - Title – Tables – Figures – Formatting and Typing.

Unit 4: **(6 Hrs)**
Biological research - Institutional Ethical committee – Animal ethical committee – Use of laboratory animals in research - Laboratory animal management

Unit 5: **(6 Hrs)**
General Laboratory Procedures – pH, Buffers, Electrodes and Biosensors – Estimation of Carbohydrates(Bradford Method) – Protein(Lowry Method) – Lipid (Soxlet Method) – Nucleic Acid (Spectrophotometry) – Techniques for Sample Preparation.

Text Books

- Dr. N. Gurumani, Research Methodology: For Biological Sciences, 2006, MJP Publishers.
- Upadhyay, Upadhyay and Nath, Biophysical Chemistry Principles and Techniques, Himalaya Publications, 1997.

Reference Books

- Y. K. Singh and R. B. Bajpai, Research Methodology Data Presentation, 2008, APH Publishing Corporation, New Delhi**.**
- Rodney Boyer, Modern Experimental Biochemistry (3rd Edition) 2000. Addison Wesley Longman, Inc.
- Wilson and Walker, A Biologists guide to Principles and Techniques of Practical Biochemistry (5th Edition) 2000 Cambridge University Press.
- David Freifelder, Physical Biochemistry, (2nd Edition) 1982, W. H. Freeman and Company, New York.

YEAR – I	INTELLECTUAL PROPERTY RIGHTS (For those students who are admitted in the year 2015 – 2016 onwards)	
SEMESTER - II		HRS/WK - 2
Elective – II B		CREDIT – 1

Objective: To make the students completely equipped with strategies of patent rights

Unit- 1 **(6Hrs)**

Introduction – Invention and Creativity – intellectual property (IP) – Importance – Protection of IPR – Basic types of property (i) Movable property (ii) Immovable property and (iii) Intellectual property.

Unit- 2 **(6Hrs)**

IP – Patents –Copy rights and related rights- Trade Marks and rights arising from trade mark registration – definitions- Industrial designs and integrated circuits – Protection of Geographical Indications at national and international levels- application procedures.

Unit- 3 **(6Hrs)**

International convention relating to intellectual property. Establishment of WIPO – Mission and Activities – History – General agreement on Trade and Tariff (GATT).

Unit- 4 **(6Hrs)**

Indian position Vs WTO and strategies- Indian IPR legislations – Commitments to WTO – Patent Ordinance and the Bill. Draft of a national Intellectual property policy- present against unfair competition.

Unit – 5 **(6Hrs)**

Case studies on patents- Basmati rice, Turmeric, Neem etc. Copy right and related rights- trademarks- Industrial Design and integrated circuits- Geographic indications – protection against unfair competition.

Text books:

- Kshitij Kumar Singh (2014) Biotechnology and Intelectual Property Rights. Pub: Springer India.
- Subbarab, N. R. Hand book of Indian Patent Law and Practice. Viswanathan printers and publishers Pvt, Ltd 1998.

Reference books:

- Paul Goldstein and Joseph Straus (2009). Intelectual Property in Asia. Pub: Springer Science& Business Media.
- Varma V.K. Law Relating to Intellectual Property Rights. 2nd Edition Pub: LexisNexis.

CLASS: I M.Sc. APPLIED MICROBIOLOGY

SUBJECT: LAB COURSE – II **SEMESTER: II**

SUB: CODE: PMBP202S

Clinical Microbiology:

1. Throat Swab
2. Blood Culture
3. Faeces Culture
4. Cholera stool sample
5. Dermatophytes – LPCB
6. Assimilation Test for yeast
7. Floatation and Sedimentation of Parasites
8. MIC Phenol Co-efficient test
9. Antibiotic Sensitivity test
10. β – Lactamase activity

Agricultural Microbiology:

1. Enumeration of bacteria from soil
2. Enumeration of fungi from soil
3. Rhizobium Isolation
4. Rhizosphere effect
5. Isolation and Enumeration of Phosphate utilizing bacteria

Industrial Microbiology:

1. Amylase production and Estimation
2. Wine Production
3. Screening for antibiotic producing bacteria
4. Microbial Limit Test

Food Microbiology:

1. MBRT
2. Resazurin Test
3. Isolation of Vibrio from marine food

Research Methodology:

1. Agarose gel electrophoresis
2. Preparation of acetate buffer
3. Lowry's method for protein estimation

YEAR – II	MICROBIAL GENE TECHNOLOGY (For those students who are admitted in the year 2015 – 2016 onwards)	PMB912S
SEMESTER - III		HRS/WK - 5
CORE - 10		CREDIT - 4

Objective:
To make the students familiar with techniques in recombination technology**.**

Unit 1: (15 Hrs)
Basic Techniques: Agarose gel electrophoresis, Nucleic acid blotting, Southern blotting, Northern blotting, Western blotting, Transformation of E.coli - **Cutting and Joining DNA molecules** - Host-controlled restriction and modification, Restriction Endonucleases, Nomenclature, Mechanical shearing of DNA, Joining DNA molecules (DNA ligase, Double linkers, Adaptors, Homopolymer tailing) Full-length cDNA cloning

Unit 2: (15 Hrs)
Plasmids as cloning vehicles for use in E.coli - Basic properties of plasmids, The purification of plasmid DNA, Desirable properties of plasmid cloning vehicles, Usefulness of 'natural' plasmids as cloning vehicles, Construction and characterization of a new cloning vehicle: pBR322, Improved vectors derived from pBR322, Direct selection vectors, Low-copy-number plasmid vectors, Runway plasmid vectors - **Bacteriophage and cosmid vectors for E.coli** - Bacteriophage λ, Vector DNA, Improved phage λ vectors, Packaging phage λ DNA in vitro, Cosmid vectors, Phasmid vectors, DNA cloning with single-stranded DNA vectors, Development of filamentous phage vectors

Unit 3: (15 Hrs)
Cloning Strategies, Gene Libraries and cDNA Cloning - Cloning strategies, Genomic DNA libraries, Chromosome walking, cDNA cloning, Full-length cDNA cloning, Genomic and cDNA libraries versus **PCR - Recombinant Selection and Screening** - Genetic methods, Selection for presence of vector, Selection of inserted sequences, Immunochemical methods, South-Western screening for DNA-binding proteins, Nucleic acid hybridization methods

Unit 4: (15 Hrs)
Expression in E.coli of Cloned DNA molecules - Expression of fusion proteins, Manipulation of cloned genes to achieve expression of native proteins, Secretion of proteins, Detecting expression of cloned genes, Maximizing the expression of cloned genes, Constructing the optimal promoter, The effect of plasmid copy number

Unit 5: **(15 Hrs)**

Cloning in Bacteria other than *E. coli* - Broad host-range vectors for cloning in Gram-negative bacteria, Vectors derived from Q group plasmids, Vectors derived from P group plasmids, Vectors derived from group W plasmid Sa, Transposons as broad host- range vectors, Cloning in *B. subtilis* - **Cloning in saccharomyces cerevisiae and other Microbial Eukaryotes** - Cloning in *Saccharomyces cerevisiae*, Cloning in Yeasts other than Saccharomyces cerevisiae, Cloning in filamentous fungi

Text Books

- Old, R.W. and S.B. Primrose, Principles of Gene manipulation, V. Edition, 1994, Blackwell Science, Oxford.
- Ernst-L. Winnacker, From Genes to Clones, 2003, Panima Publishing Corporation, New Delhi

Reference Books

- James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick, Molecular Biology of the Gene, 5th Edition, 2004, Pearson Education. Inc.
- Karl Dolica, Undeerstanding DNA and gene Cloning, 3rd Edition, 1997, John Wiley and Sons, Inc.

YEAR – II	MICROBIAL TECHNOLOGY (For those students who are admitted in the year 2015 – 2016 onwards)	PMB913S
SEMESTER - III		HRS/WK - 5
CORE - 11		CREDIT - 4

Objective:
To make the students understand the importance and application of microbes in developing and eco friendly techniques.

Unit 1: **(15 Hrs)**
Biofertilizers : Symbiotic nitrogen fixers: Rhizobium - Isolation, characterization, identification, Classification, inoculum production and field application - Frankia - Isolation, characterization – actinorrhizal nodules – non-leguminous crop symbiosis – Cyanobacteria - Azolla – Isolation, characterization, mass multiplication – Role in rice cultivation – Crop response – field application - immobilization.
Non–Symbiotic nitrogen fixers – Azospirillum - Azotobacter – Cyanobacteria - isolation, characterization, mass inoculum production and field application.

Unit 2: **(15 Hrs)**
Plant Growth Promoting Bacteria: Phosphate solubilizing microbes – Isolation characterization, mass inoculum production, field application – Phosphate solubilization mechanism. - Mycorrhiza bioinoculants – classification – importance of mycorrizal Ectomycorzhizae – Endomycorrhizae – Ectendo mycorrhizae – Taxonomy of mycorrhizae – Isolation of VA mycorrhizae – Quantification and assessment of VAM in roots – Mass inoculum production of VAM – field applications of Ectomycorrhizae and VAM.

Unit 3: **(15 Hrs)**
Bioremediation : Bioremediation of contaminated soils and wastelands. Biodegradation of xenobiotics; Ecological considerations, oil pollution, surfactants, hydrocarbons, substituted hydrocarbons, heavy metals, pesticides, herbicides - Microbes in mining, oreleaching, oil recovery - Biodegradation of noncellulosic waste for environmental conservation.

Unit 4: **(15 Hrs)**
Biopolymer and Biomass production: Microbial production of carbohydrates (PHAs, higher alkanes and methanol); Biopesticides (Bacillus thuringiensis, Pseudomonas, Trichoderma, NPV). **Biosensors**: Types and Applications. Role of microorganisms in Nanotechnology.

Unit 5: **(15 Hrs)**

Designing of microbiology laboratory – Quality assessment of Equipments, chemicals, glass wares and laboratory environments – Quality control of media and stains - Quality assurance – Overview – Definition - Quality management – Maintenance of records and reports. Quality assurance in sterilization and disinfection - Quality assessment of disposal – Biological references and standards - Good laboratory practices – Management of laboratory hazards

Text Books

- Subba Rao, N.S. Soil Microbiology, 1999, 4th Edition, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
- Sharma, A.K., Biofertilizers for Sustainable Agriculture, 2002, Agro bios India.

Reference Books

- Alexander N. Glazer and Hiroshi Nikaido, Microbial Biotechnology, 1995, W. H Freeman and Company
- Glick, B.R. and J.J. Pasternack, Molecular Biotechnology, 3rd Edition, 2003 , Panima Publishing Corporation, New Delhi, Bangalore, Indian Edition.

YEAR – II	BIOINFORMATICS (For those students who are admitted in the year 2015 – 2016 onwards)	PMB914S
SEMESTER - III		HRS/WK - 5
CORE - 12		CREDIT - 4

Objective:
To make the students familiar with recent techniques in sequence analysis using data bases.

Unit 1: **(15 Hrs)**
Historical introduction and overview – Databases – Formats – Sequence analysis – Alignment of pairs of sequences – Multiple sequence alignments – Phylogenetic tree - Database searching for similar sequences – Scoring matrices – BLAST - Gene prediction – Methods – Protein structure prediction

Unit 2: **(15 Hrs)**
Comparative Genomics: Purpose and Methods of comparison, Tools for genomic comparison: Applications of Comparative Genomics, Reconstruction of metabolic pathway, Predicting regulatory elements, Identifying targets, examination of domain function, analysis of conserved strings. Genome projects and Model Organism research -Yeast; Drosophila; C. elegans; and Mouse – a comparative analysis. Comparative genomics as an aid to gene mapping and in the study of human diseases.

Unit 3: **(15 Hrs)**
Functional Genomics: Gene expression analysis by cDNA micro arrays, SAGE, Strategies for generating ESTs and full length inserts; EST clustering and assembly; EST databases (DBEST, UNIGENE); Expression and regulation of entire set of genes, Sporulation Vs Vegetative condition in yeast and Bacillus.

Unit 4: **(15 Hrs)**
Proteomics – Protein Classification – Experimental techniques (2D Electrophoresis, Mass Spectrophotometry, Protein Micro arrays) – Ligand Screening – X ray crystal structure – NMR structures – Post translational modification prediction - Functional Proteome Analysis: Integrated Proteome Analysis - Phage antibody as tool, Protein expression analysis, High throughput analysis for proteomics

Unit 5: **(15 Hrs)**
Introduction to pharmacogenomics, process of drug development-clinical trials phase I, II and III. Pharmacogenomics in the treatment of cancer, neurodegenerative diseases, cardiovascular diseases. Pharmacogenomics in pharmaceutical industry, Ethical issues related to Pharmacogenomics and ethanopharmacology, Benefits of Pharmacogenomics.

Text Books

- SC. Rastogi, N. Mendiratta and P.Rastogi, Bioinformatics – Methods and Applications, Third edition, 2008, PHI Learning Private Limited, New Delhi.
- Dan E. Krane and Michael L. Razmer, Fundamental Concepts of Bioinformatics, 2003, Pearson Education Inc. UK

Reference Books

- David W. Mount, Bioinformatics, 2001, CBS Publishers & Distributors, New Delhi – Bangalore.
- Ed. I.S. Kohane, A.T. Kho and A.J. Buttle, Microarrays for an Integrative Genomics, 2004, Ane Books, New Delhi.

CLASS: II M.Sc. APPLIED MICROBIOLOGY

SUBJECT: LAB COURSE – III **SEMESTER: III**

SUB: CODE: PMBP303S

Microbial technology:

1. Isolation of Actinomycetes
2. Isolation and enumeration of Azospirillum from soil
3. Isolation and enumeration of Azotobacter from soil
4. Carrier based inoculum preparation for biofertilizer
5. Immobilization of Amylase enzyme
6. Sterility test

Biostatistics: (Statistics Dept.)

1. Testing the difference between means of two samples (independent)
2. Testing the difference between means of two samples (dependent)
3. Chi square test for independence of attributes
4. F – test (or) the variance ratio test
5. One way analysis of variance (anova)
6. Randomized block design (rbo)
7. Latin square design(lsd)

Bioinformatics:

1. Pairwise alignment
2. Blast

Microbial Gene Technology:

1. Agarose gel electrophoresis
2. Isolation of Bacterial Genomic DNA
3. Isolation of Plasmid DNA
4. Preparation of acetate buffer
5. Lowry's method for protein estimation

YEAR – II	GENETIC ENGINEERING (For those students who are admitted in the year 2015 – 2016 onwards)	PMB1015S
SEMESTER - IV		HRS/WK - 5
CORE - 13		CREDIT - 4

Objective:
To make the students familiar with techniques used and the importance of microbes in recombination technology.

Unit 1: **(15 Hrs)**
DNA Sequencing - DNA sequencing by the Maxam and Gilbert method, Sequencing by the chain-terminator or dideoxy procedure, Automated sequencing, Pyro sequencing, Third generation sequencing: Solexa and Illumina.

Unit 2: **(15 Hrs)**
Polymerase Chain Reaction – Introduction, Components, Variations in PCR (Multiplex, RAPD, Inverse PCR), Amplification, Specificity, Cloning PCR products, Applications. **Site Directed Mutagenesis** - Cassette mutagenesis, Primer extension: the single-primer method, PCR methods of site directed mutagenesis, Construction of genes for chimaeric proteins, Random mutagenesis.

Unit 3: **(15 Hrs)**
Plant Transgenics - Agrobacterium and genetic engineering in plants (Ti-plasmid, Disarmed Ti-plasmid derivatives as plant vectors, Binary Ti-vectors, A.rhizogenes and Ri plasmids), DNA – mediated transfection of plant protoplasts, Micro projectiles for transfecting living cells: biolistics, Plant viruses as vectors.

Unit 4: **(15 Hrs)**
Animal Transgenics – Viral Vectors, Reporter genes, Co-transfection (Co-transformation), Integration of DNA into the genome of mammalian cells, Other transformation techniques, High-level expression of foreign genes in animal cells.

Unit 5: **(15 Hrs)**
Applications of Recombinant DNA Technology - Recombinant DNA technology and the new diagnostics, Generation of novel proteins (Recombinant Insulin): protein engineering, Genetically Modified Organisms – Microorganisms (Super Bug) – Plants (Bt cotton) – Food (Golden Rice, Edible Vaccines) – Animals (Dolly).

Text Books

- Old, R.W. and S.B. Primrose, Principles of Gene manipulation, V. Edition, 1994, Blackwell Science, Oxford.
- P.K.Gupta, "Biotechnology and Genomics", 2004, Rastogi Publications.

Reference Books

- James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick, Molecular Biology of the Gene, 5th Edition, 2004, Pearson Education. Inc.
- Glick, B.R. and J.J. Pasternack, Molecular Biotechnology, 3rd Edition, 2003, Panima Publishing Corporation, New Delhi, Bangalore, Indian Edition.

YEAR – II	BIOTECHNIQUES (For those students who are admitted in the year 2015 – 2016 onwards)	EPM1016S
SEMESTER - IV		HRS/WK - 2
ELECTIVE – IV A		CREDIT - 1

Objective:
To make the students familiar with basics and advanced techniques routinely used in biosciences.

Unit 1:
Microscopic techniques: Visualization of cells and sub cellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells

Unit 2:
Microscopic techniques: scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freeze-fracture methods for EM, image processing methods in microscopy.

Unit 3:
Chromatography – Principles – Planar Chromatography (Paper and Thin – Layer) – Column Chromatography – Ion-Exchange Chromatography - Affinity Chromatography and Immunoadsorption.

Unit 4:
Advanced Chromatography - Gel Exclusion Chromatography – High Performance Liquid Chromatography (HPLC) – Gas Chromatography - LC Mass Spectrophotometry.

Unit 5:
Histochemical and immunotechniques: Flowcytometry and immunofluorescence microscopy, detection of molecules in living cells, in situ localization by techniques such as FISH and GISH.

Text Books:
- Rodney Boyer, Modern Experimental Biochemistry (3rd Edition) 2000. Addison Wesley Longman, Inc.
- Upadhyay, Upadhyay and Nath, Biophysical Chemistry Principles and Techniques, Himalaya Publications, 1997.

Reference Books
- Wilson and Walker, A Biologists guide to Principles and Techniques of Practical Biochemistry (5th Edition) 2000 Cambridge University Press.
- David Freifelder, Physical Biochemistry, (2nd Edition) 1982, W. H. Freeman and Company, New York.

YEAR – II	MOLECULAR TECHNIQUES (For those students who are admitted in the year 2015 – 2016 onwards)	
SEMESTER - IV		HRS/WK - 2
ELECTIVE – IV B		CREDIT - 1

Objective: To make the students familiar with the application of molecular techniques and its importance in research.

UNIT-1 **(6Hrs)**

Electrophoresis: Pulse field gel Electrophoresis (PFGE), Isoelectric focusing. Immunoblotting, Protein Electrophoresis, Free zone capillary Electrophoresis. Nanoproimmuno assay. Radiolabelling of peptides and proteins

UNIT-2 **(6Hrs)**

Advanced chromatographic techniques: Fast performance liquid chromatography (FPLC), size Exclusion chromatography, Hydrophobic interaction chromatography. Affinity chromatography, Reverse HPLC.

UNIT-3 **(6Hrs)**

Molecular polymorphism: Random Amplification of Polymorphic DNA(RAPD), Restriction fragment length polymorphism(RFLP) RT-Polymerase chain reaction (PCR), Peptide mass finger printing,Microarray DNA microarray, Protein Microarray ,Crisper tech.

UNIT-4 **(6Hrs)**

Extraction methods: Genomic DNA isolation from bacteria, Extraction of total RNA from bacteria, Extraction of total cellular proteins from bacteria. High speed chromosomal sorting by flow cytometry.

UNIT-5 **(6Hrs)**

Gene sequencing methods: Genomic analyzing techniques, comparative genomic hybridization, comparative genomics, gene expression profiling, wide analysis of gene expression, whole genome amplification**.** Serial analysis of gene expression. (SAGE)

TEXT BOOKS:

- Helen Kreuzer and Adrianne Massey .Recombinant DNA & Biotechnology. A guide for students.
- R.C . Sobti., Suparna.S.Pachauri .Essentials of Biotechnology.

REFERENCE BOOKS:

- Ralph. Rapley . John .M.Walker. Molecular Biomethods. Hand book. Human Press.Totowa. New Jersey.
- T.A.Brown .Gene Cloning and DNA analysis: An Introduction (7th Edition).

M.Sc. Applied Microbiology

Question Paper Pattern (Theory – Semester Examination)

Core Papers

Duration: 3 Hrs. Max. Marks: 75

Section A (5 x 5 = 25 marks)

Five out of eight questions have to be answered.
Open choice.

Minimum one question from one unit but not more than two.

Section B (5 x 10 = 50 marks)

Five out of eight questions have to be answered.
Open choice.

Minimum one question from one unit but not more than two.

M.Sc. Applied Microbiology

Question Paper Pattern (Theory – Semester Examination)

Elective Papers

Duration: 3 Hrs. Max. Marks: 75

Section A (15 x 1 = 15 marks)

Multiple choice questions.
No choice.

Minimum three questions from each unit.

Section B (5 x 12 = 60 marks)

Descriptive answers.

Five out of eight questions have to be answered.
Open choice.

Minimum one question from one unit but not more than two.

PRACTICAL EXAMINATION (PG)

Question paper pattern for the Semester Practical Examination of M. Sc. Applied Microbiology for the I, II and III Semesters

Continuous internal assessment (CIA) (40 marks)

Based on the periodical evaluation of record and experiments assessed by the staff in charge

S. No.	Category	Distribution of Marks	Total
1	Performance Based (Individually assessed by the staff-in-charge)	15	15
2	Spotters (10 nos. x 2 marks)	10	10
3	Viva voce (Individually assessed jointly by a minimum of 2 staff members)	15	15
Total			**40**

External assessment (60 marks)

Sl. No.	Category	Distribution of Marks	Total
1	Major experiments	3 x15 marks	45
2	Minor experiments	3 x 10 marks	30
3	Spotters	10 x 2 marks	20
4	Comprehensive viva		15
5	Record		10
Total			**120**

Marks obtained by the candidate in the examination will be converted to that for a maximum of 60, that is the marks obtained will be divided by 2.