



THANTHAI HANS ROEVER COLLEGE (AUTONOMOUS), ELAMBALUR, PERAMBALUR

**Bachelor of Microbiology Course Structure under CBCS**

(For the candidates admitted from the academic year 2018-2019 onwards)



Semester	Part	Course	Course Code	Title of the Course	Ins. Hours/ Weeks	Credit	Exam Hours	CIA (Max)	ESE (Max)	Total (Max)
I	I	Language Course–I (LC) – Tamil*/Other Languages ** #	18UT1	Tamil-I (Ilakiyam-Kavithai, Sirukathai, Urainadai, Ilakkiya Varalaru)	6	3	3	25	75	100
	II	English Language Course-I (ELC)	18UE1	English-I (Prose for Effective Communication and Grammar)	6	3	3	25	75	100
	III	Core Course – I (CC)	18UMB1CC1	Basic Microbiology	6	6	3	25	75	100
	III	Allied Course –I (AC)	18UMB1AC1	General Biochemistry	4	4	3	25	75	100
	III	Core Practical - I (CP)	18UMB2CP1	Basic Microbiology & Microbial Taxonomy and Physiology (P)	3	--	-	--	--	--
	III	Allied Practical -I (AP)	18UMB2AP1	General Biochemistry & Cell Biology (P)	3	--	-	--	--	--
	IV	Value Education	18UVE	Value Education	2	2	3	25	75	100
					Total	30	18			
II	I	Language Course–II (LC) – Tamil*/Other Languages ** #	18UT2	Tamil-II (Idaikkala Ilakkiyam, Nadagam, Puthinam, Ilakkiya Varalaru)	6	3	3	25	75	100
	II	English Language Course-II (ELC)	18UE2	English-II (Poetry for Effective Communication and Grammar)	6	3	3	25	75	100
	III	Core Course – II (CC)	18UMB2CC2	Microbial Taxonomy and Physiology	6	6	3	25	75	100
	III	Allied Course – II (AC)	18UMB2AC2	Cell Biology	4	2	3	25	75	100
	III	Core Practical - I (CP)	18UMB2CP1	Basic Microbiology & Microbial Taxonomy and Physiology (P)	3	3	3	40	60	100
	III	Allied Practical -I (AP)	18UMB2AP1	General Biochemistry & Cell Biology (P)	3	3	3	40	60	100
	IV	Environmental Studies	18UES	Environmental Studies	2	2	3	25	75	100
					Total	30	22			

III	I	Language Course–III (LC) – Tamil*/Other Languages ** #	18UT3	Tamil-III (Kappiya Ilakkiyam , Nadagam, Ilakiya Varalaru)	6	3	3	25	75	100
	II	English Language Course- III (ELC)	18UE3	English-III(Short Story and Effective Communication Skill)	6	3	3	25	75	100
	III	Core Course – III (CC)	18UMB3CC3	Immunology	6	6	3	25	75	100
	III	Allied Course – III (AC)	18UMB3AC3	Bioinformatics	4	4	3	25	75	100
	III	Core Practical - II (CP)	18UMB4CP2	Immunology & Bacteriology and Parasitology (P)	3	--	-	--	--	--
	III	Allied Practical - II (AP)	18UMB4AP2	Bioinformatics & Biostatistics (P)	3	--	-	--	--	--
	IV	Non Major Elective-I	18UMB3NME1	Anatomy and Physiology	2	2	3	25	75	100
				Total	30	18				500
IV	I	Language Course–IV (LC) – Tamil*/Other Languages ** #	18UT4	Tamil-IV (Palan Ilakkiyam, Ilakiya Varalaru, Podhu katturai)	6	3	3	25	75	100
	II	English Language Course- IV (ELC)	18UE4	English-IV(One Act Play and Effective Communication Skill)	6	3	3	25	75	100
	III	Core Course – IV (CC)	18UMB4CC4	Bacteriology and Parasitology	5	5	3	25	75	100
	III	Allied Course – IV (AC)	18UMB4AC4	Biostatistics	3	4	3	25	75	100
	III	Core Practical - II (CP)	18UMB4CP2	Immunology & Bacteriology and Parasitology (P)	3	3	3	40	60	100
	III	Allied Practical - II (AP)	18UMB4AP2	Bioinformatics & Biostatistics (P)	3	3	3	40	60	100
	IV	Non Major Elective-II	18UMB4NME2	Microbial Disease and Control	2	2	3	25	75	100
	IV	Skill based elective – I	18UMB4SBE1	Basic Computer Applications in Biology	2	2	3	25	75	100
			Total	30	23				800	
V	III	Core Course – V (CC)	18UMB5CC5	Virology and Mycology	5	5	3	25	75	100
	III	Core Course – VI (CC)	18UMB5CC6	Environmental and Agricultural Microbiology	5	5	3	25	75	100
	III	Core Course – VII (CC)	18UMB5CC7	Microbial Genetics and Molecular Biology	6	5	3	25	75	100
	III	Core Practical – III (CP)	18UMB5CP3	Virology and Mycology, Environmental,	3	3	3	40	60	100

				Agricultural Microbiology & Microbial genetics and Molecular biology (P)						
	III	Major based elective - I	18UMB5MBE1	Plant and Animal Biology	5	5	3	25	75	100
	IV	Skill based elective - II	18UMB5SBE2	Entrepreneurship in Microbiology	2	2	3	25	75	100
	IV	Skill based elective - III	18UMB5SBE3	Microbial Products	2	2	3	25	75	100
	IV	Soft Skills Development	18USSD	Soft Skills Development	2	2	3	25	75	100
				Total	30	29				800
VI	III	Core Course – VIII (CC)	18UMB6CC8	Food Microbiology	6	6	3	25	75	100
	III	Core Course – IX (CC)	18UMB6CC9	Industrial Microbiology	6	6	3	25	75	100
	III	Core Practical – IV (CP)	18UMB6CP4	Food Microbiology & Industrial Microbiology (P)	6	5	3	40	60	100
	III	Major based elective - II	18UMB6MBE2	Bioinstrumentation	6	6	3	25	75	100
	III	Major based elective - III	18UMB6MBE3	Bioethics and Biosafety	5	5	3	25	75	100
	V	Gender studies	18UGS	Gender studies	1	1	3	25	75	100
	V	Extension activities*			-	1	-	-	-	-
				Total	30	30				600
<b>Grand Total</b>					<b>180</b>	<b>140</b>				<b>3900</b>

**List of Allied Courses:**

First Allied Course I                      **General Biochemistry**  
 First Allied Course II                     **Cell Biology**

Second Allied Course I                  **Bioinformatics**  
 Second Allied Course II                 **Biostatistics**

**List of Non Major Elective (For 2018 – 2019)**

Elective	Semester	Course Code	Title of the Course
NME-I	III	18UBT3NME1	Mushroom and Vermitechnology
NME-II	IV	18UBT4NME2	Quality Control and Hygiene Practices

**List of Skill Based Elective (For 2018 – 2019)**

Elective	Semester	Course Code	Title of the Course
SBE-I	IV	18UMB4SBE1	Basic Computer Applications in Biology

SBE-II	V	18UMB5SBE2	Entrepreneurship in Microbiology
SBE-III	V	18UMB5SBE3	Microbial Products

**List of Major Based Elective (For 2018 – 2019)**

Elective	Semester	Course Code	Title of the Course
Elective-I	V	18UMB5MBE1	Plant and Animal Biology
Elective-II	VI	18UMB6MBE2	Bioinstrumentation
Elective-III	VI	18UMB6MBE3	Bioethics and Biosafety

**Paper Details:**

Tamil Part I	- 4
English Part II	- 4
Core Paper	- 9
Core Practical	- 4
Allied Paper	- 4
Allied Practical	- 2
Non-Major Elective	- 2
Skill Based Elective	- 3
Major Based Elective	- 3
Environmental Studies-	1
Value Education	- 1
Soft Skill Development-	1
Gender Studies	- 1
Extension Activities	- 1 (Credit Only)

\* for those who studied Tamil up to 10th +2 (Regular Stream)

+ Syllabus for other Languages should be on par with Tamil at degree level

# those who studied Tamil up to 10th +2 but opt for other languages in degree level under Part I should study special Tamil in Part IV

\*\* Extension Activities shall be outside instruction hours

Non Major Elective I & II – for those who studied Tamil under Part I

a) Basic Tamil I & II for other language students

b) Special Tamil I & II for those who studied Tamil up to 10th or +2 but opt for other languages in degree programme

**Note:**

	Internal Marks	External Marks
1. Theory	25	75
2. Practical	40	60
3. Separate passing minimum is prescribed for Internal and External marks		

**FOR THEORY**

The passing minimum for CIA shall be 40% out of 25 marks [i.e. 10 marks]

The passing minimum for Semester Examinations shall be 40% out of 75 marks [i.e. 30 marks]

**FOR PRACTICAL**

The passing minimum for CIA shall be 40% out of 40 marks [i.e. 16 marks]

The passing minimum for Semester Examinations shall be 40% out of 60 marks [i.e. 24 marks]

## SEMESTER – I

### CORE COURSE 1 - BASIC MICROBIOLOGY

**Course Code: 18UMB1CC1**

**Hours: 6**

**Credit: 6**

**Total Marks: 100**

**External Marks: 75**

**Internal Marks: 25**

#### Objectives

Basic microbiology deals with

- Basic concepts of what microorganism is & its characteristics
- Various types of microscopes
- Staining techniques for identification of microbes
- The various transport systems available for different organisms for their nutritional uptake
- Cultivation techniques for microbial isolation
- The effect of agents on microbial inhibition

#### Unit I - Introduction

Definition- scope - history of microbiology - Difference between the prokaryotic and eukaryotic microorganisms - Prokaryotic and eukaryotic structure and functions of their organelles - General introduction of classification and nomenclature – Haeckel's three kingdom concept -Whittaker's five kingdom concept-Eight Kingdom Concept- Carl woese Three Domain Concept.

#### Unit II - Microscopy

Principles - applications of simple, compound- bright field, dark field, phase contrast – fluorescent -electron microscope – Scanning Electron Microscope – Transmission Electron Microscope. Differentiation of light and electron microscope - Principles of staining- Nature of dyes -types of staining – simple, differential, negative, capsule, acid-fast - spore staining - Fungal mounting – LCB, KOH - slide culture techniques.

#### Unit III - Classifications

Classification- general characteristics - nature of Bacteria- Archaeobacteria – Cyanobacteria – Mycoplasmas – Extremophiles- Actinomycetes –Protozoa-Algae - Fungi -Viruses.

#### Unit IV – Ultra structure of prokaryotes

Microbial cell - Ultrastructure of bacteria, subcellular structures and cell envelope – slime, capsule, cell wall, pili, flagella, cell inclusions, biosynthesis of bacterial cell wall & cell membrane- Membrane transport mechanisms – diffusion, active and passive transport.

#### Unit V – Media and sterilization

Culture techniques - Types of media simple, defined, differential, selective, enriched and transport media - Sterilization: Principles and methods – physical (moist heat, dry heat, filtration, pasteurization, tyndallization, radiations) chemical (alcohols, aldehydes, phenols, halogens and hypochlorites).-Methods of maintenance - preservation of microbes.

#### Text Book:

1. Heritage, J Evans, E. G. V. and Killington,R.A. (1996). Introductory Microbiology,

Cambridge University press.

**Reference Books:**

1. Lansing M. Prescott., John P. Harley and Donald A.Klein. (2003). Microbiology (5th edi). McGraw Hill, New York.
2. Holt J.S., Krieg N.R., Sneath P.H.A. and Williams S.T (1994). Bergey's Manual of Determinative Bacteriology. (9th edition) – William & Wilkins, Baltimore.
3. James G. Cappuccino and Natalie Sheman.(1996). Microbiology-A laboratory manual.(4<sup>th</sup> edition).The Benjamin/Cummings publishing company Inc, California.
4. Moselio Schaechter. and Joshua Leaderberg. (2004). The Desk encyclopedia of Microbiology. Elseiver Academic press, California.

Total Topics	Local	Regional	National	Global
43	3	3	3	43

Green - Local    Pink - Regional    Blue - National    Brown - Global

## SEMESTER – I

### ALLIED COURSE I - GENERAL BIOCHEMISTRY

**Course Code: 18UMB1AC1**

**Hours: 4**

**Credit: 4**

**Total Marks: 100**

**External Marks: 75**

**Internal Marks: 25**

#### **Objectives**

- Mainly to know the existence of biomolecules in nature and living things
- To understand the importance of biomolecules
- To know about the proteins and enzymes classification
- To know mode of action of enzymes and membrane

#### **Unit I – Carbohydrates**

Carbohydrates - Classification and structural elucidation of glucose - fructose- Interconversion of sugars - Properties and structure - biological functions of monosaccharides, disaccharides and polysaccharides.

#### **Unit II – Proteins**

Proteins: classification and Biological importance - Primary structure, Secondary, tertiary and quaternary structure- forces stabilizing the structure of proteins - Amino acids - Structure – Classification- Essential and Non essential amino acids- Protein and Non Protein amino acids - Physical and Chemical properties of Amino acids.

#### **Unit III – Nucleic acids and Lipids**

Nucleic acid: Nucleotides and Nucleosides - Pyrimidines and Purines - DNA – Composition – Structure- forms and functions - RNA – Types and Composition - Structure and functions - Denaturation and renaturation.

Lipids: Nomenclature- Classification and Biological significance – Simple Lipids- Types of fatty acids –Triglycerides, waxes and steroids - prostaglandins and their properties - Compound lipids, Phospholipids, sphingolipids and glycolipids, Lipoproteins.

#### **Unit IV – Enzymes**

Principles of catalysis – enzyme, enzyme kinetics and enzyme regulation - mechanism of enzyme catalysis – isozymes, pKa value - Lock and key concept.

#### **Unit V – Vitamins and Hormones**

Vitamins: Sources, structure - Biological role of Vitamins - Fat soluble vitamins A,D,E and K - Water soluble vitamin B complex and vitamin C - Ascorbic acid, thiamine, riboflavin, pyridoxine, niacin, pantothenic acid, lipoic acid, biotin, folic acid and vitamin B12 - Phytohormones and plant's secondary metabolites – structure and functions of auxins, gibberellins, cytokinins and abscisic acid.

#### **Text Book:**

1. J.L. Jain, Fundamentals of Biochemistry, S. Chand & Company LTD, 1999.

**Reference Books:**

1. D.L Nelson and M.M Cox, "Lehninger's Principles of Biochemistry", W.H Freeman Publications, 5<sup>th</sup> edition, 2008.
2. Dawn, B.Markus, (1994). Biochemistry. Harwal Publishing, New York.
3. Donald voet and Judith voet. (1990). Biochemistry. John Wiley and Sons, New York.
4. Henry, R. Mahler and Eugene, H. Cerdesz, (1966). Biological Chemistry. Harper International Edition, New York.

Total Topics	Local	Regional	National	Global
45	0	0	0	45

Green - Local    Pink - Regional    Blue - National    Brown - Global

## SEMESTER – II

### CORE COURSE II - MICROBIAL TAXONOMY AND PHYSIOLOGY

**Course Code: 18UMB2CC2**

**Hours: 6**

**Credit: 6**

**Total Marks: 100**

**External Marks: 75**

**Internal Marks: 25**

#### Objectives

- Giving a broader edge to the students about the process of growth cycle, morphogenesis, endospore formation and photosynthesis
- The pathways for utilization of nutrients incorporated by the organism to gain their living

#### Unit I – Microbial taxonomy

Microbial taxonomy – definition – systematic nomenclature - hierarchical organization and the position of microbes in the living world classification systems – artificial and phylogenetic – dendrogram. Major characteristics used in taxonomy – morphological, physiological, metabolic, genetic and molecular. Numerical and chemotaxonomy of microorganisms.

#### Unit II - Growth of microorganisms

Nutritional types of microorganisms - nutritional requirements - Factors influencing the growth of microorganisms – temperature, pH, Osmotic pressure, moisture, radiations and different chemicals - Physiology of growth – Significance of various phases of growth - Growth measurements – batch, continuous and synchronous.

#### Unit III - Metabolism of carbohydrates

Anabolism – photosynthesis – exygenic – anoxygenic - synthesis of carbohydrate – catabolism of glucose – Embden Mayer – Hoff - Parnas pathway – Pentose pathway, Kreb's cycle (TCA) – electron transport system and ATP production.

#### Unit IV - Metabolism of protein & Bacterial enzymes

Metabolism of protein - Metabolic pathways of nitrogen utilization- synthesis of amino acids – peptides –proteins - Bacterial enzymes – Classification - properties – coenzymes - cofactors and isozymes.

#### Unit V - Respiration

Nitrate - sulphate - methane respiration – Fermentations – alcohol, mixed acid, lactic acid Fermentation-Amylase production – Anabolic - catabolic processes of lipids.

#### Text Book:

1. Lansing M. Prescott, John P., Harley and Donald A.Klein. (2003). Microbiology.(5<sup>th</sup> edition).McGraw-Hill company, New York.

#### Reference Books:

1. Doelle, H.W. (ed.) (2005). Microbial Metabolism, Academic Press. Gerhart, G., (1986).

Bacterial Metabolism, Springer Verlag.

2. Mathews C.K., and Holde K.E.V. (1996). Biochemistry – The Benjamin/Cummings Publishing company, Inc.
3. Murray R.K. Granner M.D., Mayes P.A. and Rodwell V.W. (1990) Biochemistry – Prentice Hall International Inc.
4. Stryer L. (1995). Biochemistry (4th edn.) W.H.Freeman and company, New York.
5. Zubey C.L. Parson W.W., and Vance D.E. (1994) Principles of Biochemistry – Wim.C. Brown Publishers, Oxford, England.

Total Topics	Local	Regional	National	Global
44	2	2	2	44

Green - Local    Pink - Regional    Blue - National    Brown - Global

**SEMESTER – II**  
**ALLIED COURSE II - CELL BIOLOGY**

**Course Code: 18UMB2AC2**  
**Hours: 4**  
**Credit: 2**

**Total Marks: 100**  
**External Marks: 75**  
**Internal Marks: 25**

**Objectives**

- To study the fundamental concepts of plant and animal cells
- To understand the process of cell cycle and cell division
- Provide the knowledge about functions of intracellular organelles
- To know about the cellular communication and cell signaling

**Unit I - Introduction**

Cells as Unit of Life - Diversity of cell size and shape - Prokaryotic and Eukaryotic cells – Isolation and growth of cells - Differences and similarities in plant and animal cells - Structure and biochemical composition of cell wall and plasma membrane – fluid mosaic model - Trilaminar model - receptor concept, sodium potassium pumps.

**Unit II - Structural organization and function of intracellular organelles**

Intracellular organelles : Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast - structure - function of cytoskeleton - role in motility.

**Unit III - Membrane structure and function**

Membrane structure and function - Structure of model membrane - lipid bilayer and membrane protein diffusion, osmosis, ion channels - active transport, ion pumps, mechanism of sorting and regulation of intracellular transport - electrical properties of membranes.

**Unit IV - Cell division and cell cycle**

Cell division and cell cycle - Mitosis and meiosis, their regulation - steps in cell cycle - control of cell cycle - Microbial Physiology – Growth ,yield – characteristics, strategies of cell division - stress response. Chromosomes - structure of chromatin and chromosomes, unique and repetitive DNA, heterochromatin, euchromatin.

**Unit V - Cellular communication**

Cellular communication - Principles of cell communication - cell adhesion - roles of different adhesion molecules - Gap junctions - extracellular matrix - Integrins - neurotransmission - Hematopoiesis and its regulation - Cell signaling - Hormones and their receptors - cell surface receptor - signaling through G-protein coupled receptors - signal transduction pathways - regulation of signaling pathways.

**Text Book:**

1. Principles of Biochemistry, Geoffrey L. Zubay, William, W. Parson, Dennis E. Vance, 1995, Wim C. Brown communications

**Reference Books:**

1. Stryer, L.1995.Biochemistry. 4th Ed. W.H. Freeman and Company, New York.

2. Biological Chemistry. Harper International Edition, New York.
3. Molecular Cell Biology, James Darnet, Harvey Lodish, David Baltimore, 1986. Scientific Americal Books Ins.,
4. Cell and Molecular Biology, E.D.P. Derobertis, E.M.F. DeRobertis, 1988. 8th edition, International edition ISBN

Total Topics	Local	Regional	National	Global
42	0	0	0	42

Green - Local    Pink - Regional    Blue - National    Brown - Global

**SEMESTER – I & II**  
**CORE PRACTICAL I - BASIC MICROBIOLOGY & MICROBIAL TAXONOMY AND PHYSIOLOGY**

**Course Code: 18UMB2CP1**

**Hours: 3**

**Credit: 3**

**Total Marks: 100**

**External Marks: 60**

**Internal Marks: 40**

**Objectives**

- Basic microbial laboratory skills.
- Handling of instruments and laboratory safety measures are included in practicals.
- Principles of Microbiology.
- Methods for Microbiology.

**Basic Microbiology**

1. Handling of instruments and laboratory safety measures are included in practicals.
2. Microscope and its operation
3. Cleaning of glassware and sterilization methods – autoclaving and hot air oven
4. Preparation of culture media
5. Demonstration of ubiquitous nature of microorganisms.
6. Quantification of microbial population by viable cell count and haemocytometer.
7. Observation of permanent slides to study the structural characteristics of algae (*Anabena*, *Nostoc*, *Spirulina*, *Oscillatoria*), fungi (*Pythium*, *Rhizopus*, *Saccharomyces*, *Pencillium*, *Aspergillus*, *Agaricus*) and protozoa (*Entamoeba histolytica* and *Plasmodium* spp.).
8. Isolation of microorganism from soil and water.
9. Pure culture techniques - Streak plate (simple, quadrant & T), Pour plate and Spread plate.
10. Test for motility of bacteria – Hanging drop method.
11. Staining techniques – Simple staining, Gram’s staining, Ziehl-Neelsen, Spore-staining and Capsular staining.
12. Isolation of fungi and cyanobacteria

**Text Book:**

1. James G. Cappucina, Natalie Sherman. (1996). Microbiology – A laboratory manual, The Benjamin (Cummings Publishing Company, Inc.)

**Reference Books:**

1. Mackie and McCartney. (1989). Practical Medical Microbiology, Churchill Livingston.
2. Albert Balows, Hens G. Truper., Martin Dworkin, Wim, Hardses, Karl-heinz Schoeifer (eds). (1992). A Hand book on the biology of bacteria, ecophysiology, isolation, identification and applications, Springer Verlag.
3. Alcamo, Fndamentals of Microbiology, Blackwell Publications
4. Aneja KR (2005). Experiments in Microbiology, Plant pathology and Biotechnology. 4th Edition, New Age International Publishers, Chennai.
5. Dubey RC and Maheswari DK (2004). Practical Microbiology 1st Edition, S.Chand & Company Ltd., New Delhi.

Total Topics	Local	Regional	National	Global
12	10	3	2	3

Green - Local    Pink - Regional    Blue - National    Brown - Global

## SEMESTER – I & II

### ALLIED PRACTICAL I – GENERAL BIOCHEMISTRY AND CELL BIOLOGY

**Course Code: 18UMB2AP1**

**Hours: 3**

**Credit: 3**

**Total Marks: 100**

**External Marks: 60**

**Internal Marks: 40**

#### Objectives

- To learn basic biochemistry techniques
- To qualitative and quantitative analyses of macromolecules
- To study the structures of macromolecules

#### Biochemistry

1. Qualitative and quantitative estimation of carbohydrates, amino acids, proteins, lipids and nucleic acids.
2. Estimation of ascorbic acid (from biological sample)
3. Estimation of glycine by formal titration method
4. Separation of lipid by TLC

#### Cell biology

1. Separation of nucleic acid bases by paper chromatography
2. Microscopy - Theoretical knowledge of light and electron microscope
3. Demonstration - Study of structure of cell organelles through electron micrographs
4. Study of the following techniques through electron / photo micrographs: Fluorescence microscopy, autoradiography, positive staining, staining, freeze fracture, freeze etching, shadow casting

#### Permanent slide preparation

1. Cytochemical staining of DNA-Feulgen
2. Cytochemical staining of DNA and RNA- Methyl Green Pyronin (MGP)
3. Cytochemical staining of Polysaccharides-Periodic Acid Schiff's (PAS)
4. Cytochemical staining of Total proteins- Bromo-phenol blue

#### Text Book:

1. Keith Wilson and John Walker. (1995). Principles & Techniques of Practical Biochemistry. (4th edition).Cambridge University press, Britain.

#### Reference Books:

1. Oser, B.L.Hawks, (1965). Physiological Chemistry, TATA McGraw Hill.
2. An introduction to practical biochemistry by David T Plummer
3. Laboratory manual in biochemistry by Pattabiraman& acharya
4. Practical biochemistry by Jayaraman
5. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
6. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
7. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. V Edition.

ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

8. Becker, W.M., Kleinsmith, L.J., Hardin, J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco

Total Topics	Local	Regional	National	Global
12	9	1	2	3

Green - Local    Pink - Regional    Blue - National    Brown - Global

## SEMESTER – III

### CORE COURSE III - IMMUNOLOGY

**Course Code: 18UMB3CC3**

**Hours: 6**

**Credit: 6**

**Total Marks: 100**

**External Marks: 75**

**Internal Marks: 25**

#### Objectives

Immunology explains

- The working of immune system and immune molecules
- Its response to antigenic substances
- Mechanisms of immune response, autoimmune disorders
- Hypersensitivity reactions of immune system
- Immuno diagnosis, cancer immunology, and transplantation immunology

#### Unit I - Introduction

Introduction - History of immunology -Immunohematology – Blood groups – Blood transfusion- Rh Erthyroblastosis - Host parasite relationship - Microbial infections- Normal flora of human body.

#### Unit II – Immune system

Structure - Composition - Function of cells - organs involved in immune system-Primary Lymphoid organs- Secondary lymphoid organs- Anatomy of lymphoid organs – Detailed aspects of T and B Cell receptor- Immunity - Innate immunity - acquired immunity- Humoral and cell mediated immunity- complement.

#### Unit III - Antigens

Antigens- Antigens, types – properties - adjuvant, vaccines, toxoides-antitoxin - Immunoglobulin – structures type and properties - Complement structure properties and functions- pathways. Theories of antibody production - MHC complex – structures - functions.

#### Unit IV - Hypersensitivity

Hypersensitivity reactions – antibody mediated-type I, anaphylaxis- Type II, antibody dependent – cytotoxicity - Type III and cell mediated immune response Type IV – lymphokines - cytokines.

#### Unit V - Antigen – Antibody reactions

Antigen-Antibody reactions - *Invitro* methods – Agglutination, Precipitation, Complement fixation, Immunofluorescence – HAI – ELISA – RIA - Flow cytometry – Fluorescence immunoblotting- *Invivo* methods –Skin tests- Immune complex tissue demonstrations.

#### Text Book:

1. Kuby, Immunology – Richard A Goldsby, Thomas J. Knidf. Barbara A. Osborne (2000) 4<sup>th</sup> Edition

#### Reference Books:

1. Tizard K (1983) Immunology- An Introduction. Sauders College Publishing, Philadelphia.
2. Roitt. I.M. (1988). Essential Immunology. Black Well Scientific Publishers.

3. Lefell, Donnenberg, A: and Rose, H. (1997). Hand book of Lunar Immunology BOCA Raton Fla;CRC Press
4. Abbas, A.K. Lichtman, A.M. and Pober, J.S. (1992). Cellular and Molecular Immunology 3<sup>rd</sup> Edition Philadelphia: M.B. Saunders.

Total Topics	Local	Regional	National	Global
53	0	0	0	53

Green - Local   Pink - Regional   Blue - National   Brown - Global

## SEMESTER – III

### ALLIED COURSE III - BIOINFORMATICS

**Course Code: 18UMB3AC3**

**Hours: 4**

**Credit: 4**

**Total Marks: 100**

**External Marks: 75**

**Internal Marks: 25**

#### Objectives

- To understand the basics of bioinformatics with biological databases
- To know about the sequence alignment tools with algorithms
- To understand about the structure prediction
- To know about the genomics and proteomic applications

#### Unit I - Introduction to Bioinformatics

Introduction: Definition – Objectives of Bioinformatics - History of Bioinformatics – Scope of Bioinformatics – Biological Data integration and analysis - Applications of Bioinformatics.

#### Unit II - Genomics and Proteomics

Genomics and Proteomics – Genomics: Functional Genomics, Structural Genomics, Pharmacogenomics, Comparative genomics – Proteomics - Functional Proteomics-Comparative proteomics – Types and applications - Human Genome Project – Systems Biology

#### Unit III - Tools for Bioinformatics

Tools for Bioinformatics: Scoring matrices – Blosum and PAM Matrix – Dot plots - Sequence Alignment – Pair wise sequence alignment – BLAST and FASTA – Gap Penalty - Alignment Algorithms: Needleman Wunsch Algorithm and Smith Waterman Algorithm - Multiple Sequence Alignment – Clustal W – Phylogenetic Analysis.

#### Unit IV - Protein Structure Prediction

Protein Structure Prediction: Secondary structure Prediction : FSSP, PDB, SCOP and CATH - Chou-Fasman method and GOR method- Comparative Modeling – Fold recognition, Ab initio prediction –Structure Visualization tools: Rasmol and Phymol.

#### Unit V - Biological Databases

Biological Databases: Genbank, Nucleic acid Sequence Databases: NCBI, EMBL and DDBJ - Protein Sequence Databases : Swiss Prot, Uniprot and PIR – Structural Databases: PDB - Literature Databases: Pubmed - Specialized sequence Databases, Pattern and motif searches.

#### Text Book:

1. Attwood T K, D J Parry-Smith, “Introduction to Bioinformatics”, Pearson Education, 2005.
2. Rastogi S.C., Namita Mendiratta, Parag Rastogi. (2011) Bioinformatics – Concepts, Skills and Applications (Second Edition) CBS Publishers, New Delhi.

#### Reference Books:

1. Arthur M. Lesk, Introduction to Bioinformatics, Oxford University Press, New Delhi, 2003.
2. Harshwardhan, P. (2005) Bioinformatics principles and application. Tata Mc Graw Hill Publishers. New Delhi.
3. Mount, D.W. 2005. Bioinformatics Sequence and genome analysis (II edition) CBS Publishers. New Delhi.

Total Topics	Local	Regional	National	Global
36	1	1	3	34

Green - Local   Pink - Regional   Blue - National   Brown - Global

**SEMESTER – III**  
**NON MAJOR ELECTIVE I - ANATOMY AND PHYSIOLOGY**

**Course Code: 18UMB3NME1**

**Hours: 2**

**Credit: 2**

**Total Marks: 100**

**External Marks: 75**

**Internal Marks: 25**

**Objective**

Helps the students to understand about the human organ of the body and its functions

**Unit I**

Basic Embryology - Osteology and Histopathology- Circulatory and respiratory Systems - Structure of Heart - Structure of lungs - Traches and its branching - Regulation of Breathing - Carrier of oxygen and Carbondioxide - Dysponea - - Blood Cell types and functions

**Unit II**

Structure and function of nervous tissues - Physiology of emotion - Regulation of temperature - Cerebro spinal fluid - sensory and organs – Tongue - Mechanism of sight, hearing and smelling.

**Unit III**

Structure of alimentary canal - Related digestive glands - Mechanism of alimentary canal ,Secretion of digestive fluids, Liver ,Function of Liver

**Unit IV**

Structure of Kidney, Bladder and Colon - Physiology of Perspiration - Physiology of urine formation, Physiology of menstruation - Physiology of defecations.

**Unit V**

Pituitary gland: Thyroid - Parathyroid glands ,Pancreas- Ovary and Testis.

**References**

1. T.S.Renganathan (2002). A text Book of Human Anatomy Rev S Chand Company Ltd, Ram Nagar, New Delhi
2. Hadley ME. (2000) Endocrinology 5<sup>th</sup> edition Prebtice Hall Upper Sasddle River NJ Martin CR Endocrine Physiology Oxford University Press
3. Charles A Jacob “Textbook of Anatomy and Physiology in Radiological Technology”The CV Mosby Company Sam Louis 1968.

Total Topics	Local	Regional	National	Global
25	0	0	0	25

Green - Local    Pink - Regional    Blue - National    Brown - Global

**SEMESTER – IV**  
**CORE COURSE IV - BACTERIOLOGY AND PARASITOLOGY**

**Course Code: 18UMB4CC4**

**Hours: 5**

**Credit: 5**

**Total Marks: 100**

**External Marks: 75**

**Internal Marks: 25**

**Objectives**

Bacteriology and Parasitology deals with

- The study of bacteria and parasites with respect to the disease causing nature and characteristics
- Microbial pathogenesis and epidemiology
- The study of disease pathology and immunology
- The study the clinical manifestations, prevention and treatment

**Unit I – Introduction of Bacteria and Parasite**

Introduction: Normal microbial flora of human body - General attributes and virulence factors of bacteria and parasites causing infections - Host Parasite relationship - Zoonotic diseases and their control - Hospital acquired infections and their control - Specimen Collection, Transport and Storage- Specimen processing (Blood, Urine, GSF, Sputum, other body fluids-collection of specimen and transport).

**Unit II – Bacterial diseases I**

Classification morphology - cultural characteristics – pathogenicity – epidemiology - laboratory diagnosis - treatment, prevention and control of diseases caused by Staphylococci, Streptococci, Pneumococci, Neisseriae (Gonococci and Meningococci) -Corynebacterium – Mycobacterium - Clostridium and Haemophilus.

**Unit III - Bacterial diseases II**

Classification morphology- cultural characteristics - pathogenicity - epidemiology - laboratory diagnosis - treatment, prevention and control of diseases caused by: Salmonella – Shigella – Vibrios - Brucella, Bordetella - Escherichia -Mycoplasmas and Ureoplasmas.

**Unit IV – Parasitic diseases I**

Classification Morphology- Pathogenicity- lab diagnosis of common protozoan diseases - Amoebiasis, Giardiasis - Balantidiosis – Trypanosomiasis – Malaria - Toxoplasmosis – Leishmaniasis -*Trichomonas vaginalis*.

**Unit V - Parasitic diseases II**

Classification Morphology – Pathogenicity - lab diagnosis of common parasitic metazoan diseases – Ascariasis ,Hook worm - Filariasis ,Hydatidosis and Taenia infection.

**Text Book:**

1. Parija, S.C. (1996). Textbook of Medical Parasitology. Orient Longman.
2. Salle, A.J. (1992). Fundamental Principles of Bacteriology. 7th Edi, Mc. Graw Hill Publishing Co. Ltd., New York.

**Reference Books:**

1. K.D. Chatterjee, M.D. Parasitology 12th Edi. Chatter (1980) Joe media Publishers Calcutta.

2. Ananthanarayanan R. and Jayaram Panicker C.K. (1994). Text book of Microbiology. Orient Longman.
3. Baron, E.J. and Finegold S.M. (1995). Scientific Company. Diagnostic Microbiology. Blackwell Scientific Company.

Total Topics	Local	Regional	National	Global
45	0	0	0	45

Green - Local    Pink - Regional    Blue - National    Brown - Global

## SEMESTER – IV

### ALLIED COURSE IV - BIostatISTICS

**Course Code: 18UMB4AC4**  
**100**

**Hours: 3**  
**Credit: 2**

**Total Marks:**

**External Marks: 75**  
**Internal Marks: 25**

#### Objectives

- To understand the various applications of statistics with reference to biological sciences

#### Unit I – Collection and Presentation of data

Statistics: Definition - Collection of data – Primary & Secondary - Population and Samples - Types of sampling – SRS - Stratified, systematic- Describing a sample - Frequency table - Frequency graphs – Data handling - Diagrammatic representation of data –Line, Bar, Pie - Histogram, Pictogram.

#### Unit II – Measures of averages and Dispersions

Mean Median and Mode - Measures of variability – Range, Mean deviation - Standard deviation and coefficient of variation- Simple problems Skewness and Kurtosis.

#### Unit III – Correlation

Correlation - types of correlation - Scatter diagram - Pearson's coefficient of correlation - Rank correlation-Tied - Repeated ranks.

#### Unit IV – Simple regression

Regression - Meaning of regression lines - Regression equations Y on X and X on Y only - Regression Coefficient - Simple problems.

#### Unit V – Tests of hypothesis

Null hypothesis – Level of Significance – Standard Error-Two kinds of errors - Chi-square test - Goodness of fit - Test for independence - F test - Equality of variances.

#### Text Book:

- Saxena H.C.: “Elementary Statistics”. S. Chand & Co., 17<sup>th</sup> Ed, 2013.

#### Reference Books:

- Gupta, S.C. and Kapoor, V.K.: “Fundamentals of Mathematical Statistics”, Sultan Chand & Sons, New Delhi, 10<sup>th</sup> Ed, 2014.

Total Topics	Local	Regional	National	Global
37	1	1	1	37

Green - Local    Pink - Regional    Blue - National    Brown - Global

## SEMESTER – III & IV

### CORE PRACTICAL II - IMMUNOLOGY & BACTERIOLOGY AND PARASITOLOGY

**Course Code: 18UMB4CP2**

**Hours: 3**

**Credit: 3**

**Total Marks: 100**

**External Marks: 60**

**Internal Marks: 40**

#### Objectives

- To diagnose infectious diseases
- To identify the medically important pathogen
- To know the knowledge about various diagnosis method
- To familiarize with morphologic criteria to differentiate the most common parasites

#### Immunology

1. ABO Blood grouping
2. Rh typing
3. WIDAL Test
4. RPR
5. CRP
6. ASO
7. Total and differential blood cell count by haemocytometer
8. Double immunodiffusion
9. Demonstration of ELISA

#### Text Book:

1. Myer's and Koshi's Manual of Diagnostic Procedures in Medical Microbiology and Immunology/Serology. Published by Department of Clinical Microbiology, CMC and Hospital, Vellore, Tamil Nadu.

#### Reference Books:

1. Ivan Roitt, Jonathan Brostoff and David Male. (2002). Immunology (6th edition). Elsevier science Ltd., New York.
2. Janis Kuby. (1994). Immunology. (2nd edition). W.H. Freeman and company, New York.
3. Lesile Hudson, Frank C.Hay, 1989. III edition. Practical Immunology. Blackwell Scientific Publication.
4. Bailey and Scott's Diagnostic Microbiology by Baron et al.

Total Topics	Local	Regional	National	Global
9	8	2	1	1

Green - Local    Pink - Regional    Blue - National    Brown - Global

**SEMESTER – III & IV**  
**ALLIED PRACTICAL II - BIOINFORMATICS AND BIOSTATISTICS**

**Course Code: 18UMB4AP2**  
**Hours: 3**  
**Credit: 3**

**Total Marks: 100**  
**External Marks: 60**  
**Internal Marks: 40**

**Objectives**

- To train the students in using basic bioinformatics techniques
- To train the students in using Ms-Excel / SPSS for solving the biological problems
- To get the knowledge about basic biological databases and tools

**Bioinformatics & Biostatistics**

1. Study of Nucleic acid sequence databanks – NCBI, EMBL and DDBJ
2. Study of Protein Structure databases – PDB, PDBSUM, SCOP and CATH.
3. Multiple sequence alignment by Clustal W
4. Evaluation of protein structure by Swiss PDB viewer and structure visualization using Rasmol tool.
5. Mean, Median and Mode (Discrete Series) and (Continuous Series)
6. Mean Deviation and Standard Deviation (Discrete Series) and (Continuous Series)
7. Chi-square test for Independence of Attributes
8. F-test for equality of sample variances

**Text Book:**

1. Rastogi S.C., Namita Mendiratta, Parag Rastogi. (2011) Bioinformatics – Concepts, Skills and Applications (Second Edition) CBS Publishers, New Delhi.
2. Gupta, S.C. and Kapoor, V.K.: “Fundamentals of Mathematical Statistics”, Sultan & Chand & Sons, New Delhi, 11<sup>th</sup> Ed, 2002.

**Reference Books:**

1. Harshawardhan, P. (2005) Bioinformatics principles and application. Tata Mc Graw Hill Publishers. New Delhi.
2. Mount, D.W. 2005. Bioinformatics Sequence and genome analysis (II edition) CBS Publishers. NewDelhi
3. Veerarajan T.. “Probability, statistics and Random processes, Tata McGraw-Hill Education, 3<sup>rd</sup> Ed, 2002.

Total Topics	Local	Regional	National	Global
8	3	2	4	3

Green - Local    Pink - Regional    Blue - National    Brown - Global

**SEMESTER-IV**  
**NON-MAJOR ELECTIVE – II - MICROBIAL DISEASE AND CONTROL**

**Course Code: 18UMB4NME2**  
**Hours: 2**  
**Credit: 2**

**Total Marks: 100**  
**External Marks: 75**  
**Internal Marks: 25**

**Objective**

Helps the students to understand about the human organ of the body and its functions

**Unit I**

Microorganisms: Microbial Interactions- pathogens - General Epidemiology, Pathogenesis, Pathology - Diagnostic Procedure- Clinical manifestation- Prevention and Control Measures.

**Unit II**

Virus : (a) HIV, (b) Pox Virus and (c) Picorna Virus - Epidemiology, Pathogenesis, Pathology- Diagnostic Procedure- Clinical manifestation- Prevention and Control Measures.

**Unit III**

Bacteria: (a) Streptococcus , (b) Staphylococcus and (c) Salmonella – Epidemiology , Pathogenesis, Pathology- Diagnostic Procedure- Clinical manifestation- Prevention and Control Measures.

**Unit IV**

Fungi: (a) Aspergillus, (b) Candida and (c) Microspora – Epidemiology, Pathogenesis, Pathology - Diagnostic Procedure- Clinical manifestation- Prevention and Control Measures.

**Unit V**

Protozoa: (a) Entamoeba histolytica, (b) Plasmodium species and (c) Trypanosoma gambiense - Epidemiology , Pathogenesis, Pathology - Diagnostic Procedure and Clinical manifestation- Prevention and Control Measures - Vectors.

**References**

1. Madingam, Martinko and Parker 2002, Biology of Microorganisms, Brock Eighth Ed Prentice Hall
2. Bala Sunramanian D, CF & Bryle & K Dharmarajan J. Green Kunthala Jayaraman (2007) Concept in Biotechnology, University Press
3. Medical Microbiology by David Green Wood Richard Slack & John Peutherer, Churchill Livingston Company
4. Textbook of Medical Parasitology, Jaypee Brothers Medical Publishers (P) Ltd. Parasitology by KP Chattergy Medical Microbiology by Jawelz, Melnick Geo R. Brokes Mc GrawHill Company
5. Medical Microbiology by Anantanarayanan & Paniker orient Longman Limited Practical Medical Microbiology by mackic & Mc Carteney.

Total Topics	Local	Regional	National	Global
25	0	0	15	10

Green - Local    Pink - Regional    Blue - National    Brown - Global

## SEMESTER – IV

### SKILL BASED ELECTIVE – II - BASIC COMPUTER APPLICATIONS IN BIOLOGY

**Course Code: 18UMB4SBE1**

**Hours: 2**

**Credit: 2**

**Total Marks: 100**

**External Marks: 75**

**Internal Marks: 25**

#### Objectives

- To understand the fundamentals of computer
- To know about the functions of operating systems
- Provide the knowledge about internet and web browsers
- To understand the process of database management systems

#### Unit I - Introduction

Introduction to Computers: History of Computers – Generation of Computers, Characteristics of Computer - Input and Output Devices ,Bits and Bytes –Binary code-Memory RAM and ROM

#### Unit II - Hardware and Software

Hardware and Software: Operating Systems – Classification of Operating Systems –Windows, Unix , Linux and disc operating systems.

#### Unit III – World Wide Web

World Wide Web: Working of Internet and Intranet – Email and its applications –Local area network- Metropolitan area network- Wide area network – Internet Protocols-Hyper Text Transfer Protocol – File Transfer protocol – Internet protocol - Network Topologies - Applications of Internet

#### Unit IV – Web Browsers

Types of files: HTML, Text and PDF –Search engines - Types and applications – Searching of information through web browsers – Internet Explorer – Firefox , Google chrome , Netscape and Opera.

#### Unit V – Applications in Biology

MS Word, Excel and Power point- Entrez, DBGET/Link, SRS - Tools in Expsy Server (GlycoMod, FindMod, AACompIdent) - Applications of Computers in Biology.

#### Text Book:

1. Alexis Leon and Mathews Leon. “Fundamentals of Information Systems” co-published by Vijay Nicole Imprints Pvt Ltd, 2004.

#### Reference Books:

1. Operating Systems – E. Madnick & John J.Donavan, Tata McGraw Hill Publishing Co., Limited
2. Harshawardhan, P. (2005) Bioinformatics principles and application. Tata Mc Graw Hill Publishers. New Delhi

Total Topics	Local	Regional	National	Global
26	3	3	3	26

Green - Local    Pink - Regional    Blue - National    Brown - Global

**SEMESTER – V**  
**CORE COURSE V - VIROLOGY AND MYCOLOGY**

**Course Code: 18UMB5CC5**  
**Hours: 5**  
**Credit: 5**

**Total Marks: 100**  
**External Marks: 75**  
**Internal Marks: 25**

**Objectives**

Virology and Mycology deals with

- The study of virus and fungi with respect to the disease causing nature and characteristics
- Microbial pathogenesis and epidemiology
- The study of disease pathology and immunology
- The study the clinical manifestations, prevention and treatment

**Unit I – Introduction of Virus and Fungi**

Virus: General properties, classification - cultivation - isolation and identification of viruses (plant and animal) – Serodiagnosis and Molecular diagnosis of viral infections - Fungi: Morphological features of fungi - Classification of medically important fungi - Diagnosis of fungal infections

**Unit II –Human diseases and Viral assays**

Human Viruses: Herpes – HIV – Hepatitis – Polio- Influenza – mumps- measles - Rubella and Cytomegalo - viruses Assays: Assay, purification and characterization of viruses - separation and characterization of viral components and quantification of viruses - Viral vaccines - Prevention and treatment of viral diseases- Antiviral agents

**Unit III – Plant, Animal and Bacterial diseases**

Plant viruses: Common plant viral diseases; TMV, Bunchy top of banana, satellite virus, Viroid – Double stranded DNA virus – Assay methods

Animal viruses: Morphology, pathogenesis - laboratory diagnosis of prions - Blue tongue, Foot and Mouth Disease

Bacterial viruses: Structure of bacteriophage , Lytic life and lysogenic life cycle

**Unit IV – Fungal diseases**

Morphology, classification, culture characters, pathogenicity - laboratory diagnosis - control and treatment of following organisms - Superficial mycosis – Pityriasis versicolor, Tinea nigra - Cutaneous mycosis – Dermatophytosis - Subcutaneous mycosis – Sporotrichosis, Mycetoma. Chromoblastomycosis

**Unit V - Fungal diseases**

Morphology, classification, culture characters, pathogenicity - laboratory diagnosis - control and treatment of following organism's - Systemic mycosis – Histoplasmosis - Opportunistic mycosis – Candidosis, Cryptococcosis – Aspergillosis - Mycotoxins- antifungal agents.

**Text Book:**

1. Jagdish Chandra. (1996) Textbook of Medical mycology. Orient Longman.
2. Ananthanarayan R & Jayaram Paniker CK (2000). Text book of Microbiology. 6th Edition, Orient Longman Limited, Chennai.

**Reference Books:**

1. Mehrotra RS and Aneja KR (1990). An introduction to Mycology. New Age International Publishers.
2. Morag C. and Timbury M.C. (1994). Medical Virology, 10th Edition. Churchill Livingstone London.
3. Dimmock N.J., Primrose S.B. (1994). Introduction to Modern Virology 4th Edi. Blackwell Sci Publications. Oxford.

Total Topics	Local	Regional	National	Global
46	0	0	0	46

Green - Local    Pink - Regional    Blue - National    Brown - Global

## SEMESTER – V

### CORE COURSE VI - ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY

Course Code: 18UMB5CC6

Hours: 5

Credit: 5

Total Marks: 100

External Marks: 75

Internal Marks: 25

#### Objectives

Agricultural and environmental microbiology explains

- The distribution of microorganisms in water and air environment
- To know the microbial interactions with living things
- To know the solid and liquid waste treatment and its usefulness
- To know the role and effect of microbes on non-living things

#### Unit I – Microbial ecology

Concepts of microbial ecology: Relationship between microorganism and different environments land, water and air - Microbiology of air – organisms in air, distribution and sources - Droplet, Droplet nuclei, aerosol - Air borne diseases - assessment of air quality - Types of aquatic ecosystems: fresh water – ponds, lakes, streams, Water borne diseases - Marine habitats – estuaries, mangroves, deepsea - Zonations – upwelling – eutrophication – food chain - Microflora of soil.

#### Unit II – Microbial interaction

Microbial interaction between microbes – Neutralism, Commensalism, Synergism, Mutualism, Amensalism, Symbiosis, Competition, Parasitism and Predation - Interaction of Microbes with plants – Rhizosphere - Mycorrhizae - Interaction of microbes with animals – insects and rumen.

#### Unit III – Waste treatment

Types of wastes – characterization of solid and liquid wastes - Solid waste treatment – saccharification, gasification and composting - Liquid waste treatment - Treatment methods – primary, secondary and tertiary treatment - Potability of water – microbial assessment of water quality – water purification.

#### Unit IV – Utilization of waste

Utilization of solid and liquid wastes- Solid waste management- Liquid waste management – food (Mushroom, yeast) - Single Cell Protein - mushroom, yeast -fuel (ethanol, methane, hydrogen) - fertilizers (composting) - fertilizers Cyanobacteria- Azolla – Azotobacter - Applications

#### Unit V – Biodeterioration and Bioremediation

Biodeterioration: Deterioration of paper, leather, wood, textiles, metal corrosion, mode of deterioration, organisms involved, its disadvantages and mode of prevention - Bioremediation – Biodegradation of toxic substances – Bio sorption – Bioleaching – Biomining - Transmission of harmful microbes through air and water.

#### Text Book:

1. Duncan Mara and Nigel Horen. (2003). The Handbook of water and waste water Microbiology. Academic press-An imprint of Elsevier.

#### Reference Books:

1. Subba Rao NS (2004). Soil Microbiology. 4th Edition, Oxford & IBH Publishing Co. Pvt.

Ltd., New Delhi.

2. Atlas, R. M. and Bartha. R. (1992). Microbial Ecology: Fundamentals and Applications. 3rd Ed. Benjamin-Cummings. Redwood city. CA.
3. Baker, W.C. and Herson, D.S.(1994). Bioremediation – McGraw Hill Inc., New York Blackie.(1998). Plant Molecular Biology. (2nd edition).Chapman Hall, New York.
4. Christon J.Hurst. (2002). Manual of Environmental Microbiology. (2nd edition).American Society for Microbiology, Washington.
5. Marshall, K.C. (1985). Advances in Microbial Ecology. Vol-8. Plenum press.

Total Topics	Local	Regional	National	Global
48	8	4	1	38

Green - Local    Pink - Regional    Blue - National    Brown - Global

**SEMESTER – V**  
**CORE COURSE VII - MICROBIAL GENETICS AND MOLECULAR BIOLOGY**

**Course Code: 18UMB5CC7**

**Hours: 6**

**Credit: 5**

**Total Marks: 100**

**External Marks: 75**

**Internal Marks: 25**

**Objectives**

- To know the genetic materials and its functions
- Various gene transfer mechanisms with applications of genetics
- To know about the rDNA technology and role of gene, vectors, enzymes and etc
- To use the technologies for nucleic acid and protein identifications

**Unit I – Introduction of genetic materials and its functions**

History: Experiments of Hershey Chase and Griffith, Avery – MacLeod-McCarty experiment - DNA as the genetic material – Properties of DNA – Forms of DNA- discovery of DNA structure – RNA as a genetic material – Replication of DNA – rolling circle model – theta model- Replication of RNA – reverse transcriptase - Transcription and Translation- Post transcriptional modification - Genetic code.

**Unit II – Vectors and Enzymes**

Vectors: Plasmids - phages and cosmids - Ti-plasmid - pBR322, pSC101, pUC - Structure and assay methods- Enzymes – Nucleases, ligases, polymerases - DNA modifying enzymes, Topoisomerases – their uses - applications.

**Unit III – rDNA technology**

Principles - applications of recombinant DNA technology - strain improvement- Biosafety guidelines – levels I, II, III and IV - GLSP - Risk Assessment and Management.

**Unit IV – Gene**

Define Gene: Concept of gene – Lac operon, tryptophan operon, attenuation control – promoters – repressors – gene expression and regulation- Gene transfer mechanisms – conjugation – transformation – transduction – Hfr transduction – Generalized – Specialized transduction.

**Unit V - Nucleic acid and protein hybridization techniques**

Nucleic acid and protein hybridization technique - Southern, Northern and Western methods of hybridization - DNA amplification techniques – PCR- DNA fingerprinting - applications.

**Text Books:**

1. David Freifelder (1999). Molecular biology, Narosa publishing House.
2. Robert H. Tamarin (2004). Principles of Genetics – 7<sup>th</sup> Edition, Tata McGraw Hill Publication, New Delhi.

**Reference Books:**

1. Friedberg E.C., Walter GC, Sied. W (1995). DNA repair and mutagenesis. ASM press.
2. Gardner, E.J. Simmons, M.J and D.P Snustard (1991). Principles of Genetics. 8<sup>th</sup> Edition John Wiley & Sons.
3. Gerald Karp (2002), Cell and Molecular Biology. 3<sup>rd</sup> Edition. John Wiley & Sons, Inc.
4. Peter J Russell (2002). Genetics – Benjamin Cummings.

5. Peter Snustard D., Michael J. Simmons (2003). Principles of Genetics, Third Edition, John Wiley & Sons..

Total Topics	Local	Regional	National	Global
48	2	2	6	44

Green - Local   Pink - Regional   Blue - National   Brown - Global

## SEMESTER – V

### CORE PRACTICAL III - VIROLOGY AND MYCOLOGY & ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY & MICROBIAL GENETICS AND MOLECULAR BIOLOGY

**Course Code: 18UMB5CP3**

**Hours: 3**

**Credit: 3**

**Total Marks: 100**

**External Marks: 60**

**Internal Marks: 40**

#### Objectives

- To diagnose infectious diseases and the medically important pathogen
- To know what types of microorganisms are found in air, terrestrial and aquatic environments
- To provide a sound background in microbial processes and their applications in agriculture
- To provide information on ecological relationship among soil microorganisms
- To isolate DNA from plasmid and bacteria
- To impart hands on training on molecular biology, genetic engineering

#### Virology and Mycology

1. Demonstration of mechanical transfer of viruses in plants
2. Demonstration of cultivation of viruses by chick embryo fibroblast technique and embryonated egg.
3. Spotters – T4 phage, M13 Phage, TMV, CaMV, HIV, Influenza, HSV, HBV, Rabies and Blue tongue virus
4. Examination of fungi by KOH and LCB staining – Dermatophytes, skin scrapping and other fungi
5. Examination of *Candida albicans* by Gram's stain, Germ tube and Sugar assimilation test.

#### Environmental and Agricultural Microbiology

1. Isolation of Rhizobium from legume nodule, cyanobacteria from water, fungi from molting leaves and *Xanthomonas malvacearum* from infected cotton plants
2. Mycorrhizae in infected plant root
3. Water analysis by MPN technique
4. Microbial assessment of air quality – open plate method and air sampler-technique.
5. Isolation and counting of faecal bacteria from water and soil

#### Microbial Genetics and Molecular Biology

1. Isolation of plasmid from bacteria, spontaneous mutant - antibiotic resistant mutants.
2. Transformation techniques.
3. Separation of proteins by polyacrylamide gel electrophoresis

#### Text Book:

1. Russell F. Bey. (2001). Microbiology Laboratory Manual, BROOKS/COLE, Australia.
- Schaechter, M. Medoff, G. and Eisenstein, B.C. (1993). Mechanism of Microbial diseases. 2nd edition. Williams & Wilkins, Baltimore.

#### Reference Books:

1. James, C. Cappuccino. (1996). Microbiology. The Benjamin/Cummings Pub. Co. California.
2. Morag, C. Timbury (1994). Medical Virology. X edition. Churchill Livingstone.
3. Jeanne Dijkstra and Cees P.de Jager.1998.Practical Plant Virology. Springer-Verlag

Berlin Heidelberg.

4. Rangaswamy, G. and Bagyaraj, D.J. (2001). Agricultural Microbiology, 2nd Ed. Prentice Hall of India Pvt. Ltd.
5. Subba Rao, N.S. (2002). Soil Microbiology, 4th Ed. (soil Microorganisms and plant growth), Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
6. Maniatis T., Fritsch E.F. & Sambrook J. Cold Spring, Molecular Cloning, A laboratory manual, Cold Spring Harbor laboratory (2002).
7. David R.W, Botstein D & Roth J.R., Advanced bacterial genetics, Cold Spring Harbor laboratory (1980).

Total Topics	Local	Regional	National	Global
13	9	2	1	1

Green - Local    Pink - Regional    Blue - National    Brown - Global

**SEMESTER – V**  
**MAJOR BASED ELECTIVE I - PLANT AND ANIMAL BIOLOGY**

**Course Code: 18UMB5MBE1**  
**Hours: 5**  
**Credit: 5**

**Total Marks: 100**  
**External Marks: 75**  
**Internal Marks: 25**

**Objectives**

- To understand the plant and animal taxonomy and classification kingdom
- Provides the knowledge about plant breeding and conventional methods
- To know about the animal cell culture and genetic engineering of animals

‘;

**Unit I – Plant and animal taxonomy**

Principles of Taxonomy as applied to the systematics - Classification of Plant Kingdom - Taxonomic structure - Biosystematics, Plant geography, Floristics.

Principles of taxonomy as applied to the systematics - classification of the animal kingdom - Classification and interrelationship amongst the major invertebrate phyla - Minor invertebrate phyla - Functional anatomy of the nonchordates - Larval forms and their evolutionary significance.

**Unit II - Evolutionary Biology**

Origin of life (including aspects of prebiotic environment and molecular evolution) - Concepts of evolution - Theories of organic evolution - Mechanisms of speciation - Hardyweineberg genetic equilibrium - genetic polymorphism and selection - Origin and evolution of economically important microbes - plants and animals.

**Unit III – Plant Breeding**

Principles of plant breeding - Important conventional methods of breeding self -cross-pollinated - vegetative propagated crops - Non conventional methods – Polyploidy - Genetic variability - Plant diseases - defensive mechanisms

**Unit IV – Genome Organization**

Plant genome organization: Organisation of chloroplast and mitochondrial genome - cytoplasmic male sterility - Genomic interaction – Protoplasmic fusion - Genetic engineering in plants - Pest resistance, Herbicide resistance - Resistance to fungi and Bacteria.

**Unit V – Gametogenesis**

Fundamentals - Facilities and Applications - Media for Animal cells - Types of cell culture - cell transformation - cell lines - stem cell cultures - Cell viability and cytotoxicity - Biology of cultured cells - Gametogenesis in animals.

**Text Books:**

2. Grierson, D., and S.N. Covey. 1988. Plant Molecular Biology. Blackie & Sons. Ltd. Glasgow.
  3. Freshney, E. D. 2000. Animal Cell Culture: A practical approach. John Wiley Pub., New York.
- Mather, J.P. and Barnes, D. (Eds.). 1998.

**Reference Books:**

1. Lycett, G.W. and D. Grierson (Eds). 1990. Genetic Engineering of Crop Plants. Heinemann, London.
2. Chrispeeds, M.J. and D.F. Sadava .1994. Plants, Genes and Agriculture.. Jones and Bartlett, Boston.
3. Mantel. S. H, Mathews. J. A, Mickee. R.A. 1985. An Introduction to Genetic Engineering in Plants. Blackwell Scientific Publishers, London
4. Animal Cell Culture Methods (Methods in Cell Biology. VOL. 57). Academic Press, London.

Total Topics	Local	Regional	National	Global
46	2	2	2	46

Green - Local    Pink - Regional    Blue - National    Brown - Global

**SEMESTER – V**  
**SKILL BASED ELECTIVE II - ENTREPRENEURSHIP IN MICROBIOLOGY**

**Course Code: 18UMB5SBE2**

**Hours: 2**

**Credit: 2**

**Objectives**

- To facilitate self-employment
- To know the organizations which helps to an entrepreneur
- To study the skills for entrepreneurs and financial supporters
- To learn the products making and marketing strategies

**Total Marks: 100**

**External Marks: 75**

**Internal Marks: 25**

**Unit I - Introduction**

Evolution of the concept of entrepreneur – Entrepreneurship: Definitions – concept of Entrepreneurship - process of Entrepreneurship - socio-economic gains.

**Unit II – Organizations and schemes**

Institutions and schemes of Government of India – Schemes and programmes- Department of Science and Technology schemes - Nationalized banks .

**Unit III - Skills for entrepreneurs**

Skills for entrepreneurs – Communication skills - problem solving skills - Business plan development- Marketing – Mix-product -distribution, price, promotion - market goal setting.

**Unit IV – Projects implementations**

Project: idea generation- Sources of idea generation - Trade Fairs and Exhibitions - vermicomposting- SCP production- Mushroom cultivation.

**Unit V – Production and marketing**

Biofertilizers production - Production of teaching kits (plasmid DNA isolation, serum electrophoresis) **Text Books:**

1. Nagendra S., (2008) Entrepreneurship and management Sanguine technical publishers
2. Bhatia, B.S. and G.S Batra, (2003) Entrepreneurship and small business management. Deep and deep publications

**Reference Books:**

1. Naidu, N.V.R, (2008) Management and entrepreneurship. I.K. International Pvt. Ltd.
2. Greene, (2000) Entrepreneurship ideas in action. Thomson learning
3. Tilak, K.V.B.R., (1990). Bacterial Biofertilizers. IARI Publications, New Delhi.
4. Venkataraman, G.S. (1972). Algal Biofertilizers and Rice Cultivation. Today and Tomorrow's Printers and Publishers, New Delhi.

Total Topics	Local	Regional	National	Global
24	3	2	8	17

Green - Local    Pink - Regional    Blue - National    Brown - Global

**SEMESTER – V**  
**SKILL BASED ELECTIVE III - MICROBIAL PRODUCTS**

**Course Code: 18UMB5SBE3**  
**Hours: 2**  
**Credit: 2**

**Total Marks: 100**  
**External Marks: 75**  
**Internal Marks: 25**

**Objectives**

- To give an idea about microbial products by using beneficial microorganisms

**Unit I – Microbes as a product**

Scope of microbial products – Diversity of microorganisms – *Spirulina, Ocillatoria, Yeasts, Streptomyces, Dunaliella* - Single cell protein

**Unit II – Commercial products**

Bioinsecticides – thuricide- Biopolymer - dextran, alginate, xanthan, PHA and its derivatives - Biotransformation of Steroids, Methanogenesis - Bioluminescence, Anticorrosive products and green fluorescence proteins.

**Unit III – Probiotics**

Probiotics: Prebiotics use of *Lactobacilli*, homo and heterolactic fermentations ,their therapeutic and nutritional value - Fermented dairy products - their nutritional values of buttermilk, acidophilus milk, cream, kefir, koumiss, and cheese and yoghurt.

**Unit IV – Primary metabolites**

Primary metabolites from algae- actinomycetes - bacteria, fungi - applications.

**Unit V – Secondary metabolites**

Drugs and bioactive compounds from algae (*Phaeophyceae* and *Chlorophyceae*) - actinomycetes (*Streptomyces* and *Micromonospora*) - bacteria (*Bacillus* and *Amycolatopsis*) - fungi (*Cephalosporium* and *Penicillium*), etc.

**Text Books:**

1. Creuger and Creuger. Biotechnology, A textbook of industrial Microbiology, Sinauer associates.
2. Baumberg. S., Hunter. I.S. and Rhodes, P.M. 1989. Microbial Products -New approaches. Cambridge Univ. Press. Cambridge.

**Reference Books:**

1. Demain, A.L , Davies, J.E. 1999. Manual of Industrial Microbiology & Biotechnology, ASM press.
2. Prescott ,L.M. Harley, J.P, Klein, D.A .1999. Microbiology , WCB Mc Graw Hill.
3. Robinson ,R.K. 1990. Dairy Microbiology, Elsevier.
4. Tortora, G.J, Funke, B.R, Case, C.L .2001. Microbiology – An introduction , Benjamin Cummings.
5. Frazier, W.C, Westhoff, D.C. 1988. Food Microbiology, TATA Mc Graw Hill

Total Topics	Local	Regional	National	Global
22	3	1	15	6

Green - Local    Pink - Regional    Blue - National    Brown - Global

**SEMESTER – VI**  
**CORE COURSE VIII – FOOD MICROBIOLOGY**

**Course Code: 18UMB6CC8**  
**Hours: 6**  
**Credit: 6**

**Total Marks: 100**  
**External Marks: 75**  
**Internal Marks: 25**

**Objectives**

Food & Dairy Microbiology explains about

- Food borne pathogens, fermentation, food quality & safety, food processing & packaging, Food laws, Food technology and product development
- Role of microbes in food production and food spoilage
- Common bacterial, viral, fungal and protozoan microbes involved in food contaminations
- Principles of biosecurity

**Unit I – Food nutrition & microbes in food**

Food – Uses - Nutrition – types of Nutrition - Food used in different ages – infants, children, school age, adult - pregnant women and old age - Importance of mother milk -Source of contamination - Food as a substrate for microbes – Microbes involved in food microbiology – Mould - Yeast - Bacteria – Factors affecting the growth of Microorganisms in food - Intrinsic and Extrinsic factors.

**Unit II – Food Preservations**

Principles of food preservation – Methods of food preservation – Physical - chemical methods – Asepsis - removal of microorganism anaerobic conditions - high temperature- low temperature- drying - food additives – Canning – **Preservation of Food.**

**Unit III – Food spoilages**

Contamination – spoilage - preservation - cereals and cereals products - sugar and sugar products - Vegetables - fruits - meat and meat products - milk and milk products- Spoilage of canned foods – Spoilage of egg and bakery products.

**Unit IV – Food borne diseases**

Food borne diseases - food poisoning – *Staphylococcus* – *Clostridium* - *Escherichia coli* - *Salmonella* - *Shigella* infections - Amoebiasis - Mycotoxins – Food poisoning – Investigation of food borne illness.

**Unit V – Quality control**

**Quality control of food products – MBRT – SPC - Phosphatase tests - Food sanitation and its control measures** - Principles of biosecurity- Origin and evolution of economically important microbes - plants and animals– Farm / plant sanitation, disinfection.

**Text Book:**

1. Frazier, W.C and Westhoff, D.C (1988). Food microbiology, 4th edition, Tata Mac Graw Hill, New Delhi.

**Reference Books:**

1. Adams, M.R and Moss M.O (1995) Food Microbiology New Age International (p) Limited Publishers.
2. Banwart, G.J., (1989). Basic Food Microbiology, 2nd Edition CBS Publishers and Distributors, New Delhi.
3. Robinson R.K (1990). Dairy Microbiology, Elsevier Applied science, London.
4. Hobbs BC Roberts D (1993). Food Poisoning and Food Hygiene Edward Arnold, London.

Total Topics	Local	Regional	National	Global
56	4	1	3	51

Green - Local    Pink - Regional    Blue - National    Brown - Global

**SEMESTER – VI**  
**CORE COURSE IX – INDUSTRIAL MICROBIOLOGY**

**Course Code: 18UMB6CC9**

**Hours: 6**

**Credit: 6**

**Total Marks: 100**

**External Marks: 75**

**Internal Marks: 25**

**Objectives**

- To study the basic concepts of fermentation.
- To study the types of upstream and downstream process
- To know about the industrial important microbial products

**Unit I - Introduction**

History - industrially important microorganisms - major classes of products - processes - Improvement of industrially important microbial strains- Industrial sterilization.

**Unit II - Up-stream processing**

Design of a fermenter - types of fermenters - basic functions - Up-stream processes –Strain selection – cultivation - seed preparation - fermentation media - formulation strategies - role of physical - other parameters for microbial growth - types of fermentation.

**Unit III - Down-stream processing**

Down-stream processes - The recovery - purification of fermentations products - intracellular - extracellular - cell disruption – precipitation – filtration – centrifugation - solvent recovery- chromatography - ultrafiltration- drying.

**Unit IV – Pharmaceutically valuable products**

Microbial products of pharmaceutical value – raw materials - organism - industrial processes involved in the production of - pencillin - vitamin B12 – insulin – Fermented beverages - Fermented oriented foods.

**Unit V – Industrially valuable products**

Microbial products of industrial value – raw materials - organism - Industrial processes involved in the production of - ethanol – vinegar – amylase – protease - glutamic acid- production of antibiotics - fermentative products – glutamine - Recycling - safe disposal of industrial wastes through microbes.

**Text Book:**

1. Reed. G. (1982). Prescott and Dunn’s Industrial Microbiology. Macmillan Publishers.
- Sikyta, B.(1983). Methods in Industrial Microbiology, Ellis Horwood limited.

**Reference Books:**

1. Click, B.R., .Pasternak, J.J. (1994). Molecular Biotechnology – ASM Press.
2. Demain A.L. Solomon, N.A. (1986). Manual of Industrial Microbiology and Biotechnology. ASM Press
3. Prave, P. Faust, V, Sitting, W., Sukatsch, D.A. (1987). Fundamentals of Biotechnology. ASM Press.
4. Stanbury, P.F. Whitaker, A. Hall, S.J. (1995). Principles of Fermentation Technology, Pergamon Press.

Total Topics	Local	Regional	National	Global
54	0	0	12	42

Green - Local    Pink - Regional    Blue - National    Brown - Global

## CORE PRACTICAL IV - FOOD MICROBIOLOGY & INDUSTRIAL MICROBIOLOGY

**Course Code: 18UMB6CP4**  
**Hours: 6**  
**Credit: 5**

**Total Marks: 100**  
**External Marks: 60**  
**Internal Marks: 40**

### Objectives

- To become familiar with methods used to determine microorganisms and their products in foods.
- To identify the types of microorganisms found in foods.
- To highlight the importance of microorganisms in the production of useful human products.
- To dispel the age long fear that microorganisms can only cause sicknesses and diseases.
- To provide the fundamental knowledge of bioinstrumentations.
- To learn the principles and working of instruments used in biology.
- To familiarize students with various medical equipments and their technical aspects.

### Food Microbiology

1. Assessment of milk quality by methylene blue reduction test
2. Isolation of bacteria from bread, tomato and any one beverage
3. Wet mount preparation of spoiled bread, tomato, grapes and potato
4. Observation of food samples to study *Leuconsostoc* sp. *Lactobacillus* sp., *Streptococcus lactis* and *Saccharomyes* sp. and etc
5. Isolation of *Lactobacilli* and *Staphylococci* from curd
6. Isolation of industrially important enzymes

### Industrial Microbiology

1. Demonstration of batch fermentation using Erlenmeyer flask
2. Wine production and estimation of ethanol
3. Whole cell immobilization – Sodium alginate
4. Screening for amylase and protease producing bacteria and fungi form soil samples

### Bioinstrumentation

1. Handling and maintenance of compound microscope
2. Handling of laboratory instruments such as Autoclave, Hot air oven, Laminar air flow and pH meter
3. Principles and operations of incubators and shakers, Centrifuge, Colorimeter and Spectrophotometer
4. Electrophoresis techniques.

### Text Book:

1. Principles of Fermentation Technology. Manual of Industrial Microbiology and Biotechnology by Demain and Devis.

### Reference Books:

1. Industrial Microbiology by Prescott and Dunns.
2. S.S. Purohit (2005) Biotechnology. Fundamental and applications 3rd Edition, Published by student edition. Behind Nasrani Cinema, Chopasani Road, Jodhpur.
3. Dubey RC and Maheswari DK (2004). Practical Microbiology 1st Edition, S.Chand &

Company Ltd., New Delhi.

- Aneja KR (2005). Experiments in Microbiology, Plant pathology and Biotechnology. 4th Edition, New Age International Publishers, Chennai

Total Topics	Local	Regional	National	Global
14	9	2	2	1

Green - Local    Pink - Regional    Blue - National    Brown - Global

**SEMESTER – VI**  
**MAJOR BASED ELECTIVE II - BIOINSTRUMENTATION**

**Course Code: 18UMB6MBE2**

**Hours: 6**

**Credit: 6**

**Objectives**

- To study the principle and working procedure of different type of instruments in biological science.
- To know the knowledge about the applications of instruments.

**Total Marks: 100**

**External Marks: 75**

**Internal Marks: 25**

**Unit I – Introduction of basic instruments**

Basic rules of a Microbiology Laboratory – Basic requirements Microbiology Laboratory – Basic principles - operating mechanism - application of autoclave - hot air oven - Laminar air flow - pH meter - Centrifuge - Basic principles of sedimentation – relative centrifugal force – Types of centrifuges (clinical, high speed, refrigerated and ultra) - Centrifugation – Principles - various types – Applications.

**Unit II – Spectrophotometry based instruments**

Calorimetry – principle - Beer Lambert’s law – Applications - Spectrophotometry – UV & Visible, Parts of a spectrophotometer – IR - NMR- Atomic absorption spectrophotometry – Applications.

**Unit III - Chromatography based instruments**

Chromatography – Paper – TLC – Column – Adsorption - Ion exchange - GC - HPLC – Principle - Applications..

**Unit IV – Electrophoresis based instruments**

Electrophoresis techniques: Proteins and nucleic acids – Types of electrophoresis – Paper, Gel, 2D PFGE , SDS PAGE- Immunoelectrophoresis.

**Unit V – Radioisotope based instruments**

Radioisotopes and their applications - Radioisotopic techniques – RIA - Detection and measurement of radioactivity – GM counter - Scintillation counter – Autoradiography - Biosensor & its types.

**Text Book:**

1. Principles of Applied Biomedical Instrumentation – A. Geddes and L.E Baker John Wiley & Sons.

**Reference Books:**

1. Keith Wilson and John Walker, 1994. Practical Biochemistry – principles and techniques. Cambridge Press
2. Instrumental methods of analysis – Den, Williard & Merrit. Asian Edition.
3. Prakash M and Arora CK. Laboratory instrumentation. Anmol Publications Pvt. Ltd.
4. Keith Wilson & John Walker (2003) Practical Biochemistry Principles & techniques. 5<sup>th</sup> edition, Cambridge university press.
5. Palanivelu P (2001). Analytical biochemistry and separation Techniques A Laboratory manual. 2<sup>nd</sup> edition, Published by Tulsi Book Centre, Madurai, Tamilnadu.

Total Topics	Local	Regional	National	Global
48	5	5	5	48

Green - Local    Pink - Regional    Blue - National    Brown - Global

**SEMESTER – VI**  
**MAJOR BASED ELECTIVE II - BIOETHICS AND BIOSAFETY**

**Course Code: 18UMB6MBE3**  
**Hours: 5**  
**Credit: 5**

**Total Marks: 100**  
**External Marks: 75**  
**Internal Marks: 25**

**Objectives**

- To know about the biosafety guidelines and regulations with biosafety levels and cabinets
- To provide the knowledge about Bioethics

**Unit I – Bioethics**

General Ethical Concerns - Reducing Genetic Diversity - Biological Warfare - Public perception of Science - Medical Ethics – Hippocratic tradition – Profession and Philanthropy - Adoption to the oath by western medicine - Retaining the Hippocratic Oath.

**Unit II – Human Embryonic Research**

Status of Human Embryo - Human Embryonic Development - Ethics through Embryo Development – Fertilization - Scientific Research on Human Embryos - Experimental goals of Human Embryo Research - Stem cell research.

**Unit III – Animal Rights**

Animal Rights - Making New Strains of Animal - Ethical limits of Animal use -Religious and Philosophical views of Animal status - Human Gene therapy - Ethics of Somatic Cell Gene Therapy – Humanized mouse - Safety of Transferred Genes – Applications of gene therapy- Research in Transgenic animals.

**Unit IV - Biosafety**

Introduction: biosafety issues in biotechnology-historical background - Introduction to Biological Safety Cabinets - Primary Containment for Biohazards - Biosafety Levels; Biosafety Levels of Specific Microorganisms -Recommended Biosafety Levels for Infectious Agents - Infected Animals- Patenting of living organisms- Patentable subjects and protection.

**Unit V - Biosafety Guidelines**

Biosafety guidelines and regulations - Operation of biosafety guidelines - regulations of Government of India - Definition of GMOs and LMOs - Roles of IBC - RCGM- GATT - GEAC - GMO applications in food - agriculture - Environmental release of GMOs - Risk Analysis - Risk Assessment - Risk management and communication - Cartagena Protocol.

**Text Book:**

1. Nancy, S. Jecker., Albert R. Johnson, Robert A. Pearlman. Bioethics: An Introduction to history, methods and practice (1997).

**Reference Books:**

1. Ethics in engineering, Martin. M.W. and Schinzinger.R. III Edition, Tata McGraw-Hill, New Delhi. 2003.

2. Sudbury, M.A.; Jones and Barlett Publishers. Tom, L. Beauchamp., Childress, F. Principles of biomedical ethics, 5th Edition, Oxford Univerisity Press. 2000.
3. Senthil Kumar Sadhasivam and Mohammed, Jaabir. 2008. IPR, Biosafety and Biotechnology Management. Jasen Publications, Tiruchirapalli, India.

Total Topics	Local	Regional	National	Global
49	1	2	15	34

Green - Local    Pink - Regional    Blue - National    Brown - Global



**Master of Microbiology Course Structure under CBCS**

(For the candidates admitted from the academic year 2018-2019 onwards)



Semester	Course	Course Code	Title of the Course	Ins. Hours/ Weeks	Credit	Exam Hours	CIA (Max)	ESE (Max)	Total (Max)
I	Core Course – I (CC)	18PMB1CC1	General Microbiology	6	4	3	25	75	100
	Core Course – II (CC)	18PMB1CC2	Medical Bacteriology and Mycology	6	4	3	25	75	100
	Core Course – III (CC)	18PMB1CC3	Virology and Parasitology	5	4	3	25	75	100
	Core Course – IV (CC)	18PMB1CC4	Microbial Biochemistry	5	4	3	25	75	100
	Core Practical – I (CP)	18PMB1CP1	General Microbiology, Bacteriology and Mycology, Virology and Parasitology & Microbial Biochemistry Practical	8	4	3	40	60	100
				Total	30	20			
II	Core Course – V (CC)	18PMB2CC5	Microbial Physiology	6	5	3	25	75	100
	Core Course – VI (CC)	18PMB2CC6	Microbial Genetics and Molecular Biology	6	5	3	25	75	100
	Core Practical – II (CP)	18PMB2CP2	Microbial Physiology & Microbial Genetics and Molecular Biology Practical	8	4	3	40	60	100
	Elective Course – I (EC)	18PMB2EC1:1	Statistical Tools for Biology	5	5	3	25	75	100
	Elective Course – II (EC)	18PMB2EC2:1	Bioinformatics and Drug Designing	5	5	3	25	75	100
				Total	30	24			
III	Core Course – VII (CC)	18PMB3CC7	Immunotechnology	6	5	3	25	75	100
	Core Course – VIII (CC)	18PMB3CC8	Food Microbiology	6	5	3	25	75	100
	Core Practical – III (CP)	18PMB3CP3	Immunotechnology & Food Microbiology Practical	8	4	3	40	60	100
	Elective Course – III (EC)	18PMB3EC3:1	IPR, Biosafety and Bioethics	5	5	3	25	75	100
	Elective Course – IV (EC)	18PMB3EC4:1	Environmental Toxicology and Management	5	5	3	25	75	100
				Total	30	24			

IV	Core Course – IX (CC)	18PMB4CC9	Bioproducts Technology	5	5	3	25	75	100
	Core Course – X (CC)	18PMB4CC10	Environmental and Agricultural Microbiology	5	5	3	25	75	100
	Core Practical – IV (CP)	18PMB4CP4	Bioproducts Technology & Environmental and Agricultural Microbiology Practical	8	4	3	40	60	100
	Elective Course – V (EC)	18PMB4EC5:1	Marine Microbiology	5	4	3	25	75	100
	Project work	18PMB4PW	Dissertation = 80 marks [2 reviewers – 20 + 20 = 40 marks Report valuation = 40 marks] Viva = 20 marks	7	4				100
			Total	30	22				500
<b>Grand Total</b>				<b>120</b>	<b>90</b>				<b>2000</b>

### List of Elective Courses (For 2018 – 2019)

Elective	Semester	Course Code	Title of the Course
Elective-I	II	18PMB2EC1:1	Statistical Tools for Biology
	II	18PMB2EC1:2	Techniques in Microbiology
Elective-II	II	18PMB2EC2:1	Bioinformatics and Drug Designing
	II	18PMB2EC2:2	Microbial Nanotechnology
Elective-III	III	18PMB3EC3:1	IPR, Biosafety and Bioethics
	III	18PMB3EC3:2	General Biology
Elective-IV	III	18PMB3EC4:1	Environmental Toxicology and Management
	III	18PMB3EC4:2	Advanced Microbial Taxonomy
Elective-V	IV	18PMB4EC5:1	Marine Microbiology
	IV	18PMB4EC5:2	Clinical Laboratory Technology

**Note:**

Project : 100 Marks  
Dissertation : 80 Marks  
Viva Voice : 20 Marks

Core Papers - 10  
Core Practical - 4  
Elective Papers - 5  
Project – 1

**Note:**

1. Theory      Internal 25 marks      External 75 marks
2. Practical    Internal 40 marks      External 60 marks
3. Separate passing minimum is prescribed for Internal and External
  - a) The passing minimum for CIA shall be 40% out of 25 marks (i.e. 10 marks)
  - b) The passing minimum for University Examinations shall be 40% out of 75

marks (i.e. 30 marks)

c) The passing minimum not less than 50% in the aggregate.

**SEMESTER – I**  
**CORE COURSE I - GENERAL MICROBIOLOGY**

**Course Code: 18PMB1CC1**

**Hours: 6**

**Credit: 4**

**Total Marks: 100**

**External Marks: 75**

**Internal Marks: 25**

**Objectives**

- To know the early developments of microbiology
- Basic concepts of what microorganism is & its characteristics, nutritional details
- Importance of the taxonomic groups and various cellular organization
- The effect of sterilization & various antimicrobial agents on microbial inhibition

**Unit I – History and Microbial Taxonomy**

History of microbiology, Microbial classification - Definition and systematics, Nomenclatural rules and identification - Haeckel's three kingdom classification, Whittaker's five kingdom approach- Eight Kingdom concept - Major characteristics used in taxonomy – Morphological and biochemical characterization of the organisms - techniques of genetical and molecular characterization of the organisms – GC%, sequencing, homology, conserved sequences and 16S rRNA analysis.

**Unit II – Bacteria and Protozoa**

Classification of bacteria according to Bergey's Manual - A note on fossil microorganisms - Morphological types - Reserve food materials – polyhydroxybutyrate, polyphosphates, cyanophycin and sulphur inclusions - Nuclear material – bacterial chromosomes and bacterial plasmids - Structure of Protozoa – classification – reproduction, characteristics of protozoa.

**Unit III – Fungi and Algae**

Fungi: Classification - cell wall, chemical composition and functions - membranes and their function - Fine structure of flagella and somatic nuclei - Structure and life cycle of fungi – Ascomycetes (*Aspergillus*), Deuteromycetes (*Candida*), Zygomycetes (*Mucor*), Basidiomycetes (*Agaricus*) - Fungi and ecosystem: saprophytes, substrate groups - Algae: Structure of algal cells – classification – reproduction, characteristics of Algae/BGA.

**Unit IV – Microbial nutrition**

Microbial nutrition: Microbial nutrient requirements – macro-nutrients, micro-elements – growth factors - sources of nutrients – nutritional classification of bacteria - Phototroph, Chemotroph, Autotroph (lithotroph), Heterotroph (organotroph), Photoautotroph, Photoheterotroph, Chemoautotroph, Chemoheterotroph - Nutritional patterns of pathogens – Saprophytes – Auxotroph - Winogradsky column.

**Unit V – Cultivation methods of microbes**

Isolation and identification of different types of bacteria - Fungi – Actinomycetes - Cyanobacteria – Protozoa - Preservation methods of microbes - Lyophilization – Cryopreservation- Store in liquid nitrogen- store in oil - Type of culture collections - Physical and chemical sterilization

**Text Book:**

1. Heritage, J. Evans E.G.V. and Killington, R.A. (1996). Introductory Microbiology. Cambridge University Press.

**Reference Books:**

1. Bernard D. Davis Renato Dulbecco. Herman N. Eisen.and Harold, S. Ginsberg. (1990). Microbiology (4<sup>th</sup> edition).J.B.Lippincott company, Newyork.
2. Alexopoulos CJ and C W. Mims. (1993). Introductory Mycology(3rd edition).Wiley Eastern Ltd, NewDelhi.
3. Elizabeth Moore-Landecker. (1996). Fundamentals of the fungi.(4th edition).Prentice Hall International, Inc, London.
4. Prescott LM, Harley JP and Klein DA (2006). Microbiology (7th edition) McGraw Hill, Newyork.
5. Schaechter M and Leaderberg J (2004). The Desk encyclopedia of Microbiology. Elseiver Academic press, California.

Total Topics	Local	Regional	National	Global
48	0	0	0	48

Green - Local    Pink - Regional    Blue - National    Brown - Global

**SEMESTER – I**  
**CORE COURSE II - MEDICAL BACTERIOLOGY AND MYCOLOGY**

**Course Code: 18PMB1CC2**  
**Hours: 6**  
**Credit: 4**

**Total Marks: 100**  
**External Marks: 75**  
**Internal Marks: 25**

**Objectives**

- To provide a comprehensive theoretical knowledge of bacteria and fungi
- To understand the basic techniques of bacterial and fungal culture
- To create awareness of bacterial and fungal diseases of human beings and causes and cures

**Unit I – General pathogenesis**

Microbial diseases - sources, route of transmission- Indigenous normal microbial flora - Pathogenesis - adhesion, invasion, host cell damage, release of pathogens - Microbial virulence and virulence factors - Signs and symptoms of microbial diseases - Host Parasite interaction- Immunity of microbial diseases.

**Unit II – Bacterial diseases I**

Morphology, classification, culture characters, pathogenicity - laboratory diagnosis - prophylaxis of following Gram-positive bacteria: *Bacillus anthracis* – *Clostridium* – *Pneumococcus* - *Corynebacterium*, - Streptococcal infections - Staphylococcal infections - Gram-negative bacteria: Enterobacteriaceae, *Salmonella* - *Shigella* - *Klebsiella* – *Proteus*- *Yersinia* - *Escheichia* - *Vibrio* – *Pseudomonas* - *Neisseria* – *Haemophilus* - *Campylobacter* – *Bordetell* - *Brucella*.

**Unit III – Bacterial diseases II**

Morphology, classification, culture characters, pathogenicity - laboratory diagnosis - prophylaxis of following organisms: *Mycoplasma* - *Mycobacterium tuberculosis* and *Mycobacterium leprae* – *Spirochetes: Treponema* and *Borrelia* - *Leptospira* - Actinomycetes - *Rickettsiae* and *Chlamydiae* - Nosocomial infections - Zoonotic diseases.

**Unit IV – Fungal diseases**

Superficial mycosis: Tinea, piedra - Cutaneous mycosis: Dermatophytosis - Subcutaneous mycosis: Sporotrichosis, Mycetoma, Rhinosporidiosis - Systemic mycosis : Histoplasmosis - Opportunistic mycosis : Candidiasis, Cryptococcosis and Aspergillosis - Ocular and dental histoplasmosis.

## Unit V – Clinical manifestation, diagnosis and Treatment

General clinical manifestation - diagnostic methods for bacterial and fungal diseases - Treatment and prevention of microorganisms - Control of microbial infections- Antimicrobial agents.

### Text Book:

1. Ananthanarayan R & CK Jayaram Paniker (2005). Text Book of Microbiology. 7<sup>th</sup> Edition, Orient Longman Private Limited

### Reference Books:

1. David Greenwood, Richard CD, Slack, John Forrest Peutherer. (1992). Medical Microbiology. 14th edition. ELBS with Churchill Livingstone
2. Ronald M. Atlas. (1989) Microbiology. Fundamentals and Applications. II edition, Maxwell Macmillan international editions. Topley & Wilson's. (1990) Principles of Bacteriology, Virology and Immunity, VIII edition, Vol. III, Bacterial Diseases, Edward Arnold, London
3. Jagadish Chander. (1996).A Text Book of Medical Mycology. Interprint, New Delhi

Total Topics	Local	Regional	National	Global
50	0	0	0	50

Green - Local    Pink - Regional    Blue - National    Brown - Global

## SEMESTER – I

### CORE COURSE III - VIROLOGY AND PARASITOLOGY

**Course Code: 18PMB1CC3**

**Hours: 5**

**Credit: 4**

**Total Marks: 100**

**External Marks: 75**

**Internal Marks: 25**

### Objectives

- To provide a comprehensive theoretical knowledge of virus and protozoa
- To understand the basic techniques of viral and parasitic cultivation and identification

### Unit I – Introduction of virology

History of viruses - nomenclature and classification of viruses -Structures and characteristics of virus - viral genome, their types and structures - Virus related agents (viroids, prions) - Cultivation of viruses in embryonated eggs, experimental animals, and cell cultures - Serological methods: Haem-agglutination, complement fixation - immunofluorescence - ELISA (3 types) and radio-immunoassays - Assay of viruses: all methods - Antiviral agents - Controlling measure of viruses.

### Unit II – Bacteriophage and Phytophaginae

Bacteriophage - structural organization - life cycle (lytic and lysogenic) - Brief details on M13, T4 and Lambda - Breif details on cyanophaginae - Classification of viruses on plants - Common virus diseases of plants - cotton and sugarcane - Type of plant viruses: TMV, Cauliflower Mosaic Virus and Potato VirusX

### Unit III – Zoophaginae

Classification - Characterization, Epidemiology, lifecycle, pathogenicity - diagnosis, prevention and treatment of RNA Viruses: Orthomyxo & Paramyxo - Rhabdo - HIV - Oncogenic viruses - DNA viruses: Pox -Herpes - Hepatitis viruses - Emerging viruses: Ebola virus - H1NI virus.

### Unit IV – Infection of Parasites

History and classification of parasites – Laboratory techniques in Parasitology - Intestinal amoebae: *Entamoeba histolytica*, – Free living amoebae – *Naegleria fowleri* - Intestinal and genital flagellates - *Giardia*, *Trichomonas*. - Blood and tissue flagellates - *Leishmania donovani*,

*Trypanosoma cruzi*. Hemosporina : Malarial Parasites - Coccidian :*Toxoplasma*,  
*Cryptosporidium*.

### Unit V - Infection of helminthes

Infection of helminthes: *Taenia solium*, *T. saginata* - *Echinococcus granulosus*, *Fasciola hepatica*, *Paragonimus westermani* - Schistosomes - *Ascaris lumbricoides*, *Ancylostoma duodenale*, *Trichuris*, *Enterobius* and *Wuchereria bancrofti*.

#### Text Book:

1. Jayaram Paniker CK. (2004). Text book of Medical Parasitology. 5th Edition, JAYPEE Brothers, Medical Publishers (P) Ltd., New Delhi

#### Reference Books:

1. Alan J.Cann (1997). Principles of Molecular virology. (2nd edition). Academic press, California.
2. Dimmock NJ, Primrose SB. (1994) Introduction to Modern Virology IV edi. Blackwell Scientific Publications, Oxford
3. Flint, S.J., Enquist, L.W., Krung, R. Racaniello, VR. and Skalka, A.M. (2000). Principles of Virology, Molecular Biology, pathogenesis and control, ASM Press, Washinton D.C.
4. Nicklin, J. Greame-Cook and Killington, R. (2003). Instant Notes in Microbiology. (2nd edition). Viva Books private limited, New Delhi.
5. Roger Hull (2002). Mathews' Plant Virology. (4th Edition). Academic press - A Harcourt Science and technology company, New York.

Total Topics	Local	Regional	National	Global
45	0	0	0	45

Green - Local    Pink - Regional    Blue - National    Brown - Global

## SEMESTER – I

### CORE COURSE IV – MICROBIAL BIOCHEMISTRY

**Course Code: 18PMB1CC4**

**Hours: 5**

**Credit: 4**

**Total Marks: 100**

**External Marks: 75**

**Internal Marks: 25**

#### Objectives

- Mainly to know the existence of biomolecules in nature and living things
- To understand biomolecules importance and their mode of action
- To know on cell metabolism, anabolism and catabolism

#### Unit I – Chemistry of life and special microbial molecules

Covalent, H-bonds - Van der Waals' interaction - Hydrophobic and hydrophilic interactions - Water as a biological solvent and its role in biological processes pH - Henderson-Hasselbalch equation - concept of buffer – Structure of Special Microbial Molecules - Peptidoglycan - bacteriorhodopsin - archaeal cell membranes and their significance in adaptation in extreme conditions - Biosynthesis of purines and pyrimidines.

#### Unit II – Enzymes and Hormones

Enzyme definition – nomenclature, classification - Factors affecting enzyme activity - active site,

co-enzyme - mechanism of enzyme action - Hormones: Classification - Mechanism of action - Role of biologically important hormones - Pituitary: Anterior, Posterior - Thyroid - Adrenal cortex, Adrenal medulla - GI hormones - Gonadal hormones.

**Unit III – Proteins**

Proteins: Structural features of amino acids - classification of amino acids - peptide linkage: partial double bond nature - determination of primary structure of polypeptide - structural classification of proteins: primary – secondary – tertiary & quaternary structures of proteins

**Unit IV – Carbohydrates and Lipids**

Carbohydrates: Monosaccharides : disaccharides, oligosaccharides, polysaccharides - concepts of epimer, isomer - Lipids: Saturated and unsaturated fatty acids, Fatty acid oxidation, Biosynthesis of fatty acids - triacylglycerols - phospholipids.

**Unit V – Metabolism**

Cell metabolism: anabolism and catabolism - Catabolic principles and break down of carbohydrates – lipids - proteins - nucleic acids - Vitamins - Water soluble and Fat Soluble vitamins - functions (co-enzyme).

**Text Book:**

1. Donald Voet and Judith G. Voet (1995). Biochemistry – Second Edition. John Willey and Sons, Inc.

**Reference Books:**

1. Christopher K. Mathews and Van Holde, K.E. (1996). Biochemistry.(2nd edition).The Benjamin/Cummings publishing company, Inc.
2. David E. Metzler. And Carol M. Metzler. (2001). Biochemistry-The chemical reactions of living cells- Vol1&2. (2nd edition).Harcourt/Academic press, Newyork.
3. Jeremy M.Berg. John L. Tymoczko and Lubert stryer (2002). Biochemistry. (5th edi). W.H.Freeman and company, Newyork.
4. Reginald, H., Garret & Charles M. Grishm. (1998). Biochemistry (Second Edition) Saunders College Publishing.
5. Trudy McKee and James R.McKee. (1999). Biochemistry-An Introduction. (2nd edition).WCB McGraw- Hill,U.S.A.

Total Topics	Local	Regional	National	Global
42	0	0	0	42

Green - Local    Pink - Regional    Blue - National    Brown - Global

**SEMESTER – I**

**CORE PRACTICAL I – GENERAL MICROBIOLOGY & BACTERIOLOGY AND MYCOLOGY & MICROBIAL BIOCHEMISTRY & VIROLOGY AND PARASITOLOGY**

**Course Code: 18PMB1CP1**

**Hours: 8**

**Credit: 4**

**Total Marks: 100**

**External Marks: 60**

**Internal Marks: 40**

**Objectives**

- To demonstrate safe practices in a microbiology laboratories
- To understand and explain causes of microbial infections
- To isolate and identification of different microorganisms

- To learn basic biochemistry tech. and study the qualitative/quantitative analyses of macromolecules

### General Microbiology

1. Direct microscopic observations: Bacteria - cocci, rods & chains; Fungi - spores, mycelium & budding
2. Serial dilution techniques, Pure culture techniques and Membrane filtration technique
3. Measurement of size of microbes – micrometry
4. Motility determination – Hanging drop method and tube method
5. Enumeration of bacterial / yeast cells-viable count (Plate count) Total count (Haemocytometer)
6. Isolation and purification of cyanobacteria, actinomycetes, fungi and protozoans

### Bacteriology and Mycology / Virology and Parasitology

1. Collection, transport and culture of clinical specimens - Sputum, pus, urine, faeces, blood and CSF
2. Isolation and identification of upper/ lower respiratory tract pathogen, gastrointestinal pathogens and urinary tract pathogens
3. Antibiotic susceptibility test - Kirby bauer technique
4. Isolation and identification of fungal pathogens from various samples
5. Direct microscopy – KOH and LCB preparations for skin scrapings for fungi
6. Germ tube, assimilation and fermentation tests for yeast

### General Biochemistry

1. Preparation of standard graph for the following and estimating the concentration in a microbial sample - glucose – anthrone method; bovine serum albumin (Lowry's method); Nucleic acid – DNA (diphenylamine method), RNA (Orcinol method)
2. Separation of aminoacids by paper chromatography and identification of amino acid

### Text Book:

1. Wilson, K. and Walker, J. (2000). Practical Biochemistry, 5th Edition, Cambridge University Press.

### Reference Books:

1. John P. Harley Microbiology Lab Manual (2007) 7th edition McGraw Hill Medical Publication division
2. Collee, J.C., Duguid, J.P., Fraser, A.C. and Marimon, B.P. (1996) Mackie and McCartney Practical Medical Microbiology, 14<sup>th</sup> Edn. Churchill Livingstone, London
3. Cappuccino and James, G (1996) Microbiology a laboratory manual, Addison Wesley Publishing Company Inc. 4th edition, England, California.
4. David R. Brooke. Bergey's Manual of Systematic Bacteriology (Vol. I), Eastern Halz, Springer Publication.

Total Topics	Local	Regional	National	Global
14	11	1	1	1

Green - Local    Pink - Regional    Blue - National    Brown - Global

**SEMESTER – II**

## CORE COURSE V – MICROBIAL PHYSIOLOGY

**Course Code: 18PMB2CC5**

**Hours: 6**

**Credit: 5**

**Total Marks: 100**

**External Marks: 75**

**Internal Marks: 25**

### Objectives

- The various transport systems available for different organisms for their nutritional uptake
- Giving a broader edge to the students about the process of Growth cycle, Morphogenesis, Endospore formation, Photosynthesis.
- The pathways for utilization of nutrients incorporated by the organism to gain their living,
- To know the microbial pigments and spores

### Unit I - Cell structure and function

Biosynthesis of peptidoglycan - Outer membrane and plasma membrane - Cytoplasmic membrane, pili, fimbriae, S-layer - Transport mechanisms- Active transport and Passive transport- Electron carriers – artificial electron donors – inhibitors , uncouplers ,energy bond - phosphorylation.

### Unit II - Microbial growth

Phases of growth curve – measurement of growth – calculations of growth rate – generation time – synchronous growth – induction of synchronous growth, synchrony index – factors affecting growth – pH, temperature, substrate and osmotic condition – Extremophiles - Bioluminescence - mechanism & advantages.

### Unit III – Energy and Regulation

Energy and Regulation: Energy and work-law of thermodynamics - spontaneity of reaction  $G$ ,  $G^\circ$ ,  $G'$  and equilibrium - Role of ATP in metabolism- oxidation- reduction - Electron carriers- artificial electron donors, inhibitors, uncouplers, and energy bond - Significance and metabolic regulation- Electron Transport chain.

### Unit IV - Carbon catabolism

Carbohydrates: anabolism, autotrophy – oxygenic, anoxygenic - Photosynthesis – autotrophic generation of ATP; fixation of  $CO_2$ : Calvin cycle – C3-C4 pathways - Respiratory metabolism : Embden Mayer Hoff pathway – Enter Doudroff pathway – glyoxalate pathway – Krebs cycle – oxidative and substrate level phosphorylation – reverse TCA cycle – gluconeogenesis – Fermentation of carbohydrates: homo and heterolactic fermentations.

### Unit V – Microbial pigments and spores

Pigments: Brief details of autotrophic and heterotrophic pigments - Brief account of chlorophyll , fluorescences, phosphorescences - bacteriochlorophyll and rhodopsin and carotenoids - phycobiliproteins - Brief account on Dormancy - Spores: Cell division – bacterial endospore - Microbial development, sporulation and morphogenesis - Hyphae vs yeast forms and their significance - Multicellular organization of selected microbes.

### Text Book:

1. Caldwell, D.R. (1995). Microbial Physiology and metabolism, Wm. C. Brown Publishers, USA

### Reference Books:

1. Lansing M. Prescott, John P. Harley and Donald A. Klein. (2003). Microbiology. (5<sup>th</sup> edition). McGraw-Hill company, Newyork.
2. Pelczar Jr, M.J. Chan, E.C.S. and Kreig, N.R. (1993). Microbiology, Mc. Graw Hill. Inc, New York.
3. White, D. (1995). The physiology and biochemistry of Prokaryotes, Oxford University

Press, Oxford, New York.

Total Topics	Local	Regional	National	Global
53	1	1	1	53

Green - Local    Pink - Regional    Blue - National    Brown - Global

## SEMESTER – II

### CORE COURSE VI – MICROBIAL GENETICS AND MOLECULAR BIOLOGY

**Course Code: 18PMB2CC6**

**Hours: 6**

**Credit: 5**

**Total Marks: 100**

**External Marks: 75**

**Internal Marks: 25**

#### Objectives

- To make a detailed study on the blue print of life and the information centers called genes
- To expose the mechanism and function of gene transfer methods
- To know about rDNA technology, mutagenesis and transposable elements

#### Unit I – Introduction

Premendelian genetic concepts – Preformationism, epigenesis, inheritance of acquired characters, traits, Germplasm theory - Hereditary and Environment, Genotype and Phenotype - Microbes as genetic tools for genetic studies - Identification of genetic material – Griffith experiment- Hershey and Chase Experiment - DNA replication - Meselson -Stahl experiment.

#### Unit II - Gene

Organization of Gene - Operon concept - lac and trp operons, promoters and repressor - Regulation of gene expression – Transcriptional control – promoters, terminators, attenuators and anti-terminators; Induction and repression - Translational control – ribosome binding, codon usage, antisense RNA - post-transcriptional gene silencing & modification

#### Unit III – Protein synthesis and Transfer mechanisms

Process of transcription - Synthesis of mRNA in prokaryotes and eukaryotes - Synthesis of rRNA and tRNA - cDNA library - RNA processing – capping and polyadenylation - Genetic code and process of translation - Signal sequences - protein transport - Brief details on Transformation (competence cells, regulation, general process) - Transduction (general and specialized) - all Conjugation methods.

#### Unit IV – rDNA technology

Vectors: plasmids – cosmids - phages - Restriction enzymes - Principles - applications of recombinant DNA technology - Biosafety guidelines and Measures: levels I, II, III and IV.

#### Unit V – Transposons and Mutagenesis

Discovery insertion sequences - complex and compound transposons – T10, T5, and retroposon – Insertion sequences – Mechanism – Transposons of E.coli - Bacteriophage - Yeast - Definition and types- Spontaneous mutation and induced mutation - DNA damage and repair mechanism.

#### Text Book:

1. Malacinski GM & Freifelder D (1998) Essentials of Molecular Biology, 3 edition, John and Bartlett Publis.

#### Reference Books:

1. Friedberg EC, Walker GC, Siede W. (2005). DNA repair and mutagenesis. ASM press  
James D. Watson, Tania A. Baker, Stephen P. Bell, and Alexander Gann (20080, Molecular

Biology of the Gene, Fifth Edition.

2. Antony JF, Griffiths, Gilbert WM, Lewontin RC and Miller JH (2002). Modern Genetic Analysis, Integrating Genes and Genomes, 2nd edition, WH.
3. Maloy SR, Cronan Jr. JE, Freifelder D (1994). Microbial genetics. Jones and Bartlett publishers.
4. Singer M, Berg P. (1991). Genes and Genomes. University Science Books.
5. Watson JD, Hopkins NH, Roberts JW, Steitz JA, Weiner AM. (1998). Molecular biology of the gene, 4th edition, Benjamin/Cummings publishing company.

Total Topics	Local	Regional	National	Global
48	0	0	1	47

Green - Local    Pink - Regional    Blue - National    Brown - Global

## SEMESTER – II

### CORE PRACTICAL II – MICROBIAL PHYSIOLOGY & MICROBIAL GENETICS AND MOLECULAR BIOLOGY

**Course Code: 18PMB2CP2**

**Hours: 8**

**Credit: 4**

**Total Marks: 100**

**External Marks: 60**

**Internal Marks: 40**

#### Objectives

- To know the basics of metabolism including nutritional growth, anabolism and catabolism
- To appreciate the metabolic diversity existing in microbes
- To familiarize with morphologic criteria to differentiate the most common parasites
- To understand the principles and applications of microbial genetic methods

#### Microbial Physiology

1. Bacterial growth curve – Turbidity
2. Effect of various factors influence the growth of microbes – pH, T° and Nutrients
3. Biochemical tests – Indole, MR, VP, Citrate, TSI
4. Urease, Catalase, Oxidase, etc
5. Carbohydrate fermentation test

#### Genetics

1. Isolation of antibiotic resistant microbes
2. Induction of mutation by ultra-violet radiation and chemical mutagens – NTG, MNNG. Transformation (competent cell preparation)
3. Transduction using P1
4. Isolation of microbial genomic DNA
5. Isolation of Plasmid DNA from *E.coli* (mini preparation)
6. Demonstration: Bacterial conjugation
7. Transfer of drug resistant factor (Plasmid)
8. Restriction digestion of DNA
9. DNA amplification – PCR analysis
10. Blotting techniques: Southern Blotting: RAPD and RFLP

## 11. Principle and separation of AG and SDS PAGE

### Text Book:

1. Dubey, R.C. and Maheshwari, D.K. (2002) Practical Microbiology, 1<sup>st</sup> Edn. S. Chand & Co. Ltd., New Delhi.

### Reference Books:

1. Atlas Ronald, M., Bartha, and Richard (1987). Microbial Ecology 2<sup>nd</sup> Edition. Benjamin/Cummings Publishing Company, California.
2. Current protocols in molecular biology (2007), Vol. 1 & 2. John Wiley & Sons Inc.
3. Sambrook J and Russell DW (2001) Molecular cloning - A laboratory manual (3rd edition, Vol 1,2,3), Cold Spring Laboratory Press.
4. Gerhardt, P., Murray, R.G., Wood, W.A. and Kreig, N.R. 1994. Methods of General and Molecular Bacteriology, Ed.
5. Surzyeki S (2000). Basic Techniques in Molecular Biology. Springer.
6. Dharmalingam, K. 1986. Experiments with MI3 gene cloning and DNA sequencing, Published by Wasani for MacMillan India Limited.

Total Topics	Local	Regional	National	Global
16	10	3	1	2

Green - Local    Pink - Regional    Blue - National    Brown - Global

## SEMESTER – II

### ELECTIVE COURSE I – STATISTICAL TOOLS FOR BIOLOGY

Course Code: 18PMB2EC1:1

Hours: 5

Credit: 5

Total Marks: 100

External Marks: 75

Internal Marks: 25

### Objectives

- To imbibe statistical techniques applicable in biological sciences.
- To expose the essential ideas about designing and executing and interpreting statistical field experiments.

### Unit I – Sampling Techniques

Complete enumeration Vs. Sampling – need and limitations of sampling design - Organization and Execution of Sample Surveys - Essential aspects of Sample Survey - Pilot Survey - Sources of Error in a survey - Sampling and Non-sampling errors - Probability and Non Probability Sampling Techniques.

### Unit II – Test of significance for large samples

Test of Significance for Single Sample Proportion - Two Sample Proportions - Single Sample Mean - Two Sample Means - Single Sample Variance - Two Sample Variances - Simple Problems.

### Unit III – Test of significance for small samples

Test of significance for means - variances - correlation coefficient - regression coefficient - based on t, Chi-square - F-distributions - its applications – Simple problems.

### Unit IV – Design of experiments

Fundamental principles of experimentation – Randomization - Replication - Local control techniques - Uniformity trials – Transformation of data and its uses - Analysis of variance- One way and Two way classification - missing plot technique - Analysis of CRD - RBD - LSD.

**Unit V – Epidemiological Analysis**

Definition and uses of vital statistics – Measures of mortality – C.D.R. - S.D.R. & A.S.D.R. – Central Mortality Rate – Force of Mortality – Measures of Fertility – C.B.R. - G.F.R. - A.S.F.R. and T.F.R.

**Text Book:**

1. Gupta, S.C. and Kapoor, V.K.: Fundamentals of Applied Statistics, Sultan Chand & Co., 11th ed., 2002 (Units I, IV and V).

**Reference Books:**

1. Gupta, S.C. and Kapoor, V.K.: “Fundamentals of Mathematical Statistics”, Sultan & Chand & Sons, New Delhi, 11th Ed, 2002. (Units II and III)
2. William G. Cochran.: Sampling Techniques, John Wiley Sons, 1999.
3. Das, M.N. and Giri, N.C.: Design and analysis of Experiments, New age International Publication 2nd ed, 1986.
4. Kendall, M. and Stuart, A.: “The advanced theory of Statistics” Vol. II, Charles Griffin, 1961.

Total Topics	Local	Regional	National	Global
45	1	0	0	44

Green - Local    Pink - Regional    Blue - National    Brown - Global

**SEMESTER – II**

**ELECTIVE COURSE I – TECHNIQUES IN MICROBIOLOGY**

**Course Code: 18PMB2EC1:2**

**Hours: 5**

**Credit: 5**

**Total Marks: 100**

**External Marks: 75**

**Internal Marks: 25**

**Objectives**

Techniques in Microbiology deals with

- To study the principle and working procedure of different type of instruments in biological science
- To know the knowledge about the applications of instruments
- The methods available for the separation of biomolecules, 1° and 2° metabolites
- To study the advanced conventional and modern (molecular) microbiological instruments

**Unit I – Microscopy and Centrifugation**

Microscopy: Principles - applications, simple, compound - phase-contrast - fluorescent microscopes -Electron microscopy: SEM and TEM - Confocal laser scanning microscopy - Centrifugation Techniques: Principles - type of centrifuges - buoyant and density gradient centrifugation- desktop centrifuge- ultracentrifuges.

### Unit II – Spectroscopy

Spectroscopy: Electromagnetic spectrum - Beer Lambert’s Law - Photometry, UV/VIS Spectrophotometry - Infrared spectroscopy - Atomic absorption spectroscopy (AAS) - ESR and H and C NMR spectroscopy - Mass spectroscopy (LC-MS, GC-MS) - Fluorescent spectroscopy - principle, instrumentation - application of MALDI-ToF.

### Unit III - Chromatography

Chromatography: Introduction and types of chromatography - paper, thin layer, gas, partition, Gel permeation, ion-exchang - HP-TLC - HPLC - FPLC and affinity chromatography, instrumentation - Applications of Chromatographic techniques in Microbiology.

### Unit IV – Electrophoresis and Blotting techniques

Electrophoresis and Blotting techniques - Paper and gel electrophoresis - PAGE (native and SDS), Agarose gel electrophoresis, PFGE - Blotting: Southern, Western and Northern blotting, Immunoblotting - Labelling and Detection methods - Nature and types of radiations: preparation of labelled biological samples - Detection and measurement of radioactivity - GM counter - Scintillation counter, Autoradiography, Flow cytometry - Safety measures in handling radioisotopes - Principles of Radio Immuno Assay - non-radiolabelling.

### Unit V – DNA sequencing methods

DNA sequencing methods: Major landmarks in DNA sequencing - Maxam-Gilbert sequencing - Chain-termination methods - Advanced methods and *de novo* sequencing, Shotgun sequencing, Next-generation methods - Massively Parallel Signature Sequencing (MPSS), Polony sequencing, 454 pyrosequencing, Illumina (Solexa) sequencing, SOLiD sequencing, Ion semiconductor sequencing - DNA nanoball sequencing - Heliscope single molecule sequencing - Single molecule real time (SMRT) sequencing.

### Text Book:

1. Surzeki, S. (2000). Basic Techniques in Molecular Biology, Springer.

### Reference Books:

1. Glick, B.R. and Pasternak, J.J. (1994). Molecular Biotechnology, ASM Press.
2. John G. Webster. (20 04). Bioinstrumentation. University of Wisconsin, John Wiley & Sons, Inc.
3. Sambrook, J. and Ruseell, D.W. (2001) Manual of Molecular Cloning (3rd edition) Cold Spring Laboratory Press.
4. Westermeier, R (1993). Electroporesis in practice – VCH – Federal Republic of Germany.
5. Willett, J.E. (1991). Gas Chromatography, John Wiley & Sons.
6. Wilson, K. and Walker (1995). Practical Biochemistry Principles and Techniques, Cambridge University Press.

Total Topics	Local	Regional	National	Global
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51	2	2	2	49
Green - Local	Pink - Regional	Blue - National	Brown - Global	

**SEMESTER – II**  
**ELECTIVE COURSE II – BIOINFORMATICS AND DRUG DESIGNING**

**Course Code: 18PMB2EC2:1**  
**Hours: 5**  
**Credit: 5**

**Total Marks: 100**  
**External Marks: 75**  
**Internal Marks: 25**

### **Objectives**

- To understand the biological databases and tools
- To know about the sequence alignment algorithms
- To understand about the structure prediction and visualization tools
- To know about the methods and applications of drug designing

### **Unit I – Biological Databases**

Genbank - Nucleic acid and Protein Sequence Databases - Structural Databases - Literature Databases – Pubmed- Biological database- NCBI-EMBL-DDBJ - Sequence Analysis: Pair wise sequence alignment – BLAST and FASTA – Gap Penalty - Alignment Algorithms: Needleman Wunsch Algorithm and Smith waterman Algorithm - Multiple Sequence Alignment –Phylogenetic Analysis- Phylip.

### **Unit II – Genomics**

Sequencing Genomes – Sequence Assembly - Functional Genomics - Structural Genomics, Pharmaco genomics – Comparative genomics - Proteomics – Structural and Comparative proteomics - applications - Human Genome Project – Gene Prediction.

### **Unit III - Proteomics**

Predicting Protein structure and function– Determination of structure - Secondary structure prediction- FSSP, PDB- Swissprot-PIR- SCOP and CATH - Chou-Fasman method –GOR method- Protein Modeling – Fold recognition – Ab initio prediction - Structure Visualization tools – Rasmol and Phymol.

### **Unit IV – Macromolecular Modeling**

Macromolecular modeling- Software tools for modeling bio-molecules - Molecular electrostatic potentials, charge analyses - Protein conformations, folding and mutation through modeling-design of ligands for known macro molecular target sites - Drug-receptor interaction, classical SAR/QSAR studies and their implications to the 3-D modeler, 2-D and 3-D database searching- Predicting 3D structure.

### **Unit V – Drug Designing**

Advanced Drug Design Methods - Structure activity relationship, Pharmacokinetics, Pharmacophoric pattern, ADMET Properties - Quantitative Structure Activity Relationship (QSAR) - Docking-Rigid and Flexible – Structure based drug design - Finding new drug targets to treat disease- strategies for target identification and lead design- New targets for anticancer drugs.

### **Text Book:**

1. Rastogi S.C., Namita Mendiratta, Parag Rastogi. (2011) Bioinformatics – Concepts, Skills and Applications (Second Edition) CBS Publishers, New Delhi.
2. Attwood T K, D J Parry-Smith, “Introduction to Bioinformatics”, Pearson Education, 2005.

### **Reference Books:**

1. Arthur M. Lesk, Introduction to Bioinformatics, Oxford University Press, New Delhi, 2003.

2. Alan Hinchliffe. 2003. Molecular Modelling for Beginners, John-Wiley and Sons NewYork.
3. Cohen, N. (Ed.).1996. Guide Book on Molecular Modeling in Drug Design, Academic Press, San Diego.
4. McCammon, J.A. and S.C. Harvey. 1987. Dynamics of Proteins and Nucleic Acids.Cambridge University Press.
5. Shanmughavel, P. 2006. Trends in Bioinformatics, Pointer Publishers, Jaipur, India.
6. Hansch, Corwin, Leo, Albert, Hockma, D.H. 1995. Exploring QSAR. American Chemical Society, Washington D.C.

Total Topics	Local	Regional	National	Global
52	0	0	15	37

Green - Local    Pink - Regional    Blue - National    Brown - Global

**SEMESTER – II**  
**ELECTIVE COURSE II – MICROBIAL NANOTECHNOLOGY**

**Course Code: 18PMB2EC2:2**  
**Hours: 5**  
**Credit: 5**

**Total Marks: 100**  
**External Marks: 75**  
**Internal Marks: 25**

**Objectives**

- To impart the knowledge of nano science and its application in biology
- To improve the knowledge about recombinant products with help of advanced techniques

**Unit I - Introduction**

History - bionanotechnology - concept and future prospects - application in life sciences - Terminologies – nanotechnology – bionanotechnology – nanomedicine – nanowires - quantum Dots - nanocomposite, nanoparticles.

**Unit II - Molecular nanotechnology**

Molecular nanotechnology - nanomachines – collagen - Uses of nanoparticles - cancer therapy - manipulation of cell and biomolecules - Cytoskeleton and cell organelles - Types of nanoparticles production - physical, chemical and biological - Microbial synthesis of nanoparticles – Applications of nanoparticles.

**Unit III - Nanoparticles**

Nanoparticles - types, functions - Silver, Gold and Titanium - Physical - chemical properties of nanoparticles - Characterization of nanoparticles - UV-Vis spectroscopy - Electron Microscopy: HR TEM, SEM - AFM- EDS - XRD.

**Unit IV - Applications**

Applications of nanoparticles in biology - Drug delivery - protein mediated and nanoparticle mediated. - Uses of nanoparticles in MRI, DNA and Protein Microarrays - Nanotechnology in health sectors - Toxicology in nanoparticles - Dosimetry.

**Unit V – Significance of nanoparticles**

Advantages of nanoparticles - drug targeting - protein detection - MRI, development of green chemistry - commercial viability of nanoparticles - Disadvantages - health risk associated with nanoparticles - inadequate knowledge on nanoparticles research.

**Text Book:**

1. Parthasarathy, B.K. (2007). Introduction to Nanotechnology, Isha Publication.

## Reference Books:

1. Elisabeth Papazoglou and Aravind Parthasarathy (2007). Bionanotechnology. Morgan & Claypool Publishers.
2. Bernd Rehm (2006). Microbial Bionanotechnology: Biological Self-assembly Systems and Biopolymer-based Nanostructures. Horizon Scientific Press.
3. David E. Reisner, Joseph D. Bronzino (2008). Bionanotechnology: Global Prospects. CRC Press.
4. Ehud Gazit (2006). Plenty of Room for Biology at the Bottom: An Introduction to Bionanotechnology. Imperial College Press.

Total Topics	Local	Regional	National	Global
47	4	4	4	47 nn m

Green - Local    Pink - Regional    Blue - National    Brown - Global

## SEMESTER – III CORE COURSE VII – IMMUNOTECHNOLOGY

**Course Code: 18PMB3CC7**

**Hours: 6**

**Credit: 5**

**Total Marks: 100**

**External Marks: 75**

**Internal Marks: 25**

### Objectives

- To study in detail the components of the immune system
- To learn the immunological basis of infectious diseases, cancer and transplantation
- To learn the immunological testing's for disease diagnosis and treatment

### Unit I - Introduction

Introduction to the field of Immunology: Discovery of humoral and cellular immunity Types of Immunity: Innate immunity - Acquired immunity: (specific) natural, artificial, active and passive immunity - macrophages, neutrophils, Natural killer cells, mast cells, basophils, and eosinophils.

### Unit II - Antigens and Antibodies

Antigens and Antibodies: Immunogenicity versus Antigenicity - Nature of antigens - Role of T helper cells in B cell activation - Antibody-structure and functions-subtypes - structural basis of Antibody diversity - Complement pathway

### Unit III - Organs, and tissues of immune system

Organs, and tissues of immune system: Primary - Secondary Lymphoid organs - Thymus , Bone marrow - Lymph node, spleen and tonsils, GALT - cells of the humoral Immunity (HI) - Cell mediated Immunity (CMI) - Immune tolerance - Antigen presenting cells (APCs) - T lymphocytes - B lymphocytes. MHC restriction –Tissue and HLA typing – Transplantation- Rejection of Transplantation.

### Unit IV – Immunological disorders

Immune system Disorders - Hypersensitivities -Type I to Type IV -Immunodeficiency diseases; Primary and secondary immune deficiencies -Auto immune diseases-organ specific and systemic - Vaccines–definition, conventional vaccines - modern trends in development of vaccines - recombinant - DNA vaccines

### Unit V – Immuno-techniques

Immuno-techniques and Immuno-diagnosis: Antigens and Antibody reactions - *in vitro*; precipitation agglutination, complement fixation – ELISA - Western Blotting - I Immunoelectrophoresis – Immunofluorescence - Immuno-precipitation - Radioimmunoassay - Flow cytometry

### Text Book:

1. I.Roitt. Essential Immunology. 10th ed. Blackwell Science, 2005

### Reference Books:

1. Kuby Immunology- 6th edition. Publisher W. H. Freeman & Company
2. Janways Immunobiology. 7th edition. Publisher-Garland Science, 2007
3. Ivan M. Roit (1994) Essential Immunology – Blackwell Scientific Publications, Oxford
4. Eli Benjamini, Richard Coico, G. Sunshine. Immunology- A Short Course. 4th Ed. Wiley’s Publication, 2000.

Total Topics	Local	Regional	National	Global
42	0	0	0	42

Green - Local    Pink - Regional    Blue - National    Brown - Global

## SEMESTER – III

### CORE COURSE VIII – FOOD MICROBIOLOGY

**Course Code: 18PMB3CC8**

**Hours: 6**

**Credit: 5**

**Total Marks: 100**

**External Marks: 75**

**Internal Marks: 25**

### Objectives

- Study about food preservation, spoilage and detection of pathogens using advanced techniques.
- To study about importance and benefit of microbes in food production and processing industry

### Unit I - Introduction

Importance of food microbiology - Types of microorganisms in Food Spoilage - source of contamination- Factors - Intrinsic and Extrinsic parameters – affecting / influencing microbial growth in food.

### Unit II – Food Fermentation

Microbiology of Food fermentations: Milk, Fermentation, Fermented and Non-fermented Dairy Products - Food fermentations - Manufacture of fermented foods - Meat and fishery products - plant products- Sauerkraut and fermented breads – beverages - Microbial cells as food - SCP - mushroom cultivation. - Source - applications of microbial enzymes - antioxidants, bio-

surfactants, polysaccharides, flavors - colors - Probiotics and their advantages - genetically modified foods.

### Unit III – Contamination and Spoilage

Contamination and spoilage of dairy and dairy products - cereals and cereals products - sugar and sugar products - vegetables and fruits - meat and meat products – fish and other sea foods - egg and poultry - Fermentative dairy products (ice cream, Yoghurt and Kefir) - Food borne disease - intoxication and food poisoning – Staphylococcus – EPEC – Diarrhea - Clostridium - Escherichia coli and Salmonella infections.

### Unit IV – Food Preservations

Food Preservations: Principles- Methods of Preservations-Physical - chemical methods.

### Unit V – Food safety and Quality management

Food safety and Quality Management Systems: General principles of food safety risk management - Recent concerns on food safety - Food additives - Safe food alternatives (Organic foods) - Good agricultural Practices (GAP) - Food Indicators of water and food safety and quality- Microbiological criteria of foods and their Significance - Good manufacturing practices (GMP) and Good laboratory practices (GLP) - HACCP and personnel hygiene - ISO systems for food safety.

#### Text Book:

1. Frazier and Westhoff, DC. 1988. Food Microbiology. TATA McGraw Hill Publishing Company LTD., New Delhi

#### Reference Books:

1. Adams, M.R and Moss, MO. 1995. Food Microbiology. The Royal Society of Chemistry, Cambridge.
2. James M. Jay., Loessner, M. J., and Golden D. A., 2005, Modern Food Microbiology, Seventh edition.
3. Verma, L.K. and Joshi, V. K., 2000, Post Harvest Technology of Fruits and Vegetables, Tata McGraw Hill Publication.
4. Banwart GJ. 1989. Basic food microbiology, Chapman & Hall, New York.

Total Topics	Local	Regional	National	Global
50	10	3	11	32

Green - Local    Pink - Regional    Blue - National    Brown - Global

## SEMESTER – III

### CORE PRACTICAL III – IMMUNOTECHNOLOGY & FOOD MICROBIOLOGY

**Course Code: 18PMB3CP3**

**Hours: 8**

**Credit: 4**

**Total Marks: 100**

**External Marks: 60**

**Internal Marks: 40**

#### Objectives

- To learn the advanced immunological techniques
- To learn the microbiological quality of foods

### **Immunotechnology**

1. Collection of venous blood from human and separation and preservation of serum / plasma
2. Immunization of protocols and raising antibody
3. ABO Blood grouping – Rh typing and cross matching
4. Agglutination tests - WIDAL – slide and tube test
5. RA test
6. ASO test
7. HCG test
8. CRP test

### **Food Microbiology**

1. Detecting Milk Quality by Methylene Blue Reductase (MBRT) test
2. Enumeration/ Viable count Plate of Microbial population of fruits, vegetables, meat, soft drinks and preserved foods
3. Milk coagulase test
4. Preservative efficacy test
5. Complete microbiological analysis of various food products.

### **Text Book:**

1. Dubey RC and Maheswari DK (2004). Practical Microbiology 1st Edition, S.Chand & Company Ltd., New Delhi.

### **Reference Books:**

1. Immunology (2000) by K. R. Joshi, N.O. Osama, Agrobios Ltd, India.
2. Donal M. Weir, John Steward (1993) Immunology – VII edition. ELBS, London Richard M. Hyde (1995). Immunology III edition. National Medical series, Williams and Wilkins, Harward Publishing company.
3. Ward, O.P. 1989. Fermentation Biotechnology: Principles, Processes and products. Prentice Hall Engle wood Cliff..
4. Peppier, H,J and Prelman, D.1979. Microbial tech & Fermentation tech.. Vol.1 and II. Academic Press. NY.

Total Topics	Local	Regional	National	Global
13	10	1	1	1

Green - Local    Pink - Regional    Blue - National    Brown - Global

## **SEMESTER – III**

### **ELECTIVE COURSE III – IPR, BIOSAFETY AND BIOETHICS**

**Course Code: 18PMB3EC3:1**

**Hours: 5**

**Credit: 5**

**Total Marks: 100**

**External Marks: 75**

**Internal Marks: 25**

## Objectives

- To know about the biosafety guidelines and regulations with biosafety levels and cabinets
- To understand the basic concepts in IPR with agreement and treaties
- To provide the knowledge about Bioethics

## Unit I - Introduction to Intellectual Property Rights (IPR)

Intellectual Property Rights (IPR)- Patents – Copyrights – Trademarks - Trade Secrets - Importance of IPR – patentable and non-patentable products, patenting life - Industrial Design -Traditional Knowledge - Geographical Indications- legal protection of biological inventions – World Intellectual Property rights Organization (WIPO).

## Unit II – Patent Filing Procedures

National and Patent Cooperation Treaty filing procedure -Time frame and cost - Status of the patent applications filed, Precautions while patenting – disclosure and non-disclosure while patenting - Financial assistance for patenting - Patent licensing, Patent Agreement, Patent infringement.

Agreements and Treaties: GATT Agreement, TRIPS Agreement , Madrid Agreement ,Hague Agreement - WIPO Treaties, Budapest Treaty - Patent Cooperation Treaty - Indian Patent Act 1970 and recent amendments.

## Unit III - Biosafety

Introduction - Biosafety issues - Historical background - Introduction to Biological Safety Cabinets, Biohazards - Biosafety Levels of Specific Microorganisms - Recommended Biosafety Levels for Infectious Agents and infected animals.

## Unit IV – Biosafety Guidelines

Biosafety guidelines and regulations - Operation of biosafety guidelines and regulations of Government of India - Definition of GMOs and LMOs - Roles of IBC, RCGM, GEAC - GMO applications in food and agriculture - Environmental release of GMOs - Risk Analysis - Risk Assessment; Risk management and communication - Cartagena Protocol.

## Unit V - Bioethics

Introduction to Bioethics: Microbiology and ethics, Benefits and risks of genetic engineering – Reducing Genetic Diversity - Biological warfare – Gene therapy: Ethics of somatic cell gene therapy - Germ line therapy, Embryonic and adult stem cell research - Medical ethics: Hippocratic tradition, Profession and Philanthropy, Western medicine – Animal Rights - Making New strains of Animals.

## Text Book:

2. Senthil Kumar Sadhasivam and Mohammed, Jaabir. 2008. IPR, Biosafety and Bitechology Management. Jasen Publications, Tiruchirapalli, India.

**Reference Books:**

1. Ethics in engineering, Martin. M.W. and Schinzinger.R. III Edition, Tata McGraw-Hill, New Delhi. 2003.
2. BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007
3. Kankanala, K. C. 2007. Genetic Patent Law & Strategy, 1st Edition. Manupatra Information Solution Pvt. Ltd., Noida, India.
4. Nancy, S. Jecker., Albert R. Johnson, Robert A. 1997. Pearlman. Bioethics: An Intro. to history, methods and practice
5. Sudbury, M.A.; Jones and Barlett Publishers. Tom, L. Beauchamp., Childress, F. Principles of biomedical ethics, 5th Edition, Oxford University Press. 2000.
6. Hoosetti, B.B. 2002. Glimpses of Biodiversity. Daya, New Delhi.
7. <http://www.cbd.int/biosafety/background.shtml>
8. <http://web.princeton.edu/sites/ehs/biosafety/biosafetypage/section3.html>

Total Topics	Local	Regional	National	Global
44	2	1	23	20

Green - Local    Pink - Regional    Blue - National    Brown - Global

**SEMESTER – III**  
**ELECTIVE COURSE III – GENERAL BIOLOGY**

**Course Code: 18PMB3EC3:2**  
**Hours: 5**  
**Credit: 5**

**Total Marks: 100**  
**External Marks: 75**  
**Internal Marks: 25**

**Objectives**

- To understand the plant taxonomy and classification kingdom
- Provides the knowledge about plant breeding and conventional methods
- To know about the animal cell culture and genetic engineering of animals

**Unit I – Biosystematics**

Principles of Taxonomy as applied to the systematics - Classification of Plant Kingdom: Taxonomic structure – Biosystematics - Plant geography - Floristics.

Principles of taxonomy as applied to the systematics - classification of the animal kingdom: Classification and interrelationship amongst the major invertebrate phyla - Minor invertebrate phyla - Functional anatomy of the nonchordates.

**Unit II - Evolutionary Biology**

Origin of life (including aspects of prebiotic environment and molecular evolution) - Concepts of evolution - Theories of organic evolution - Mechanisms of speciation - Hardyweineberg genetic equilibrium - genetic polymorphism and selection - **Origin and evolution of economically important microbes; plants and animals.**

**Unit III – Plant Breeding**

Principles of plant breeding - Important conventional methods of breeding self - cross pollinated - vegetative propagated crops - Non conventional methods – Polyploidy - Genetic variability - Plant diseases and defensive mechanisms.

**Unit IV – Genome Organization**

Plant genome organization: Organisation of chloroplast and mitochondrial genome - cytoplasmic male sterility - Genomic interaction – Protoplasmic fusion - Genetic engineering in plants: Pest resistance, Herbicide resistance - Resistance to fungi and Bacteria.

**Unit V - Animal Cell Culture**

Fundamentals: **Facilities and Applications** - Media for Animal cells - Types of cell culture - cell transformation - cell lines, stem cell cultures, Cell viability and cytotoxicity - Biology of cultured cells - measurement of growth - cell synchronization- cryopreservation – Gametogenesis - Genetic engineering in animals - methods of DNA transfer into animal cells- Hybridoma technology - Vaccine production - Gametogenesis in animals - Molecular events during fertilization..

**Text Book:**

1. Grierson,D., and S.N. Covey. 1988. Plant Molecular Biology. Blackie& Sons. Ltd. Glasgow.

## Reference Books:

1. Lycett, G.W. and D. Grierson (Eds) .1990.Genetic Engineering of Crop Plants. Heinemann, London.
2. Chrispeeds, M.J. and D.F. Sadava .1994. Plants, Genes and Agriculture.. Jones and Bartlett, Boston.
3. Mantel. S. H, Mathews. J. A, Mickee. R.A. 1985. An Introduction to Genetic Engineering in Plants. Blackwell Scientific Publishers, London
4. 1. Freshney, E. D.2000. Animal Cell Culture: A practical approach. John Wiley Pub.,New York. 2. Mather, J.P. and Barnes, D. (Eds.). 1998.
5. Animal Cell Culture Methods (Methods in Cell Biology. VOL. 57). Academic Press, London.

Total Topics	Local	Regional	National	Global
47	2	2	2	47

Green - Local    Pink - Regional    Blue - National    Brown - Global

## SEMESTER – III

### ELECTIVE COURSE IV – ENVIRONMENTAL TOXICOLOGY AND MANAGEMENT

**Course Code: 18PMB3EC4:1**

**Hours: 5**

**Credit: 5**

**Total Marks: 100**

**External Marks: 75**

**Internal Marks: 25**

## Objectives

- To understand the human impacts on the ecosystems
- To learn the role of toxic substances and their nexus on environment
- To know the EIA, EIS & EMP details and basic concept of environmental management

## Unit I – Introduction of environmental toxicology

Brief details about air- water - soil - noise pollution - sources, measurement, indices and mitigation - Toxic chemicals in the environment - air, water & their effects - Impact of anthropogenic activity.

## Unit II – Toxic materials and their impacts

Pesticides in water - Biochemicals aspects of arsenic, cadmium, lead mercury, carbon monoxide, ozone and PAN pesticide - Mode of entry of toxic substance - biotransformation of xenobiotics - detoxification, bioleaching - Carcinogens in air - chemical carcinogenicity - mechanism of carcinogenicity - Environmental carcinogenicity testing.

## Unit III – Toxic chemicals vs Eco-health

Insecticides - MIC effects - Concept of major, trace and Rare Earth Element (REE)- possible effects of imbalance of some trace elements - Biogeochemical factors in environmental health - Epidemiological issues goiter - fluorosis, arsenic poisoning.

## Unit IV – Introduction of environmental management

Introduction - scope of environmental management - basic concepts of sustainable development - industrial ecology and recycling industry - Role of natural products and bio-diversity in international trade - fundamentals of fossil fuels use - energy production and trade - energy balance and energy audit - Eco-marketing – Ecomanagement system.

## Unit V – EIA, EIS and EMP

Environmental Impact Assessment (EIA) - general guidelines for the preparation of environmental impact statement (EIS) - scope and types of environmental audit - cost benefit analysis - environmental management plan (EMP) - international organization for standardization (ISO) - ISO 14000 standards and certification - environmental clearance for establishing industry - environmental safety - risk management and emergency preparedness - international summit and treaties - important dates dedicated to environmental management.

**Text Book:**

1. Stake, M. Y. Mido, M.S. Sethi, S.A. Iqbal, H. Yasuhisa, S. Taguchi (1997) environmental Toxicology, Discovery publishing house, New Delhi.

**Reference Books:**

1. Casseret, L. J and Doull, J (1982) Toxicology. The basic science of Poisons. Macmillan publishers, New York.
2. De, A. K. (1986) Environmental Chemistry, Willey Eastern Limited, New Delhi.
3. Timbrel (1989) Elements Toxicology, British Council Library.
4. Trivedy, R. K (1994) Encyclopaedia of Environmental Pollution and Control. Enviromedia publications, Karad.
5. Munn, R. E. (1982) Environmental Impact Assessment. McGraw-Hill, New York.

Total Topics	Local	Regional	National	Global
45	0	0	7	38

Green - Local    Pink - Regional    Blue - National    Brown - Global

**SEMESTER – III**

**ELECTIVE COURSE IV – ADVANCED MICROBIAL TAXONOMY**

**Course Code: 18PMB3EC4:2**

**Hours: 5**

**Credit: 5**

**Total Marks: 100**

**External Marks: 75**

**Internal Marks: 25**

**Objectives**

- To learn the basic knowledge about microbial taxonomy and phylogeny
- To gain the knowledge about advanced microbial identification studies

**Unit I – Introduction of Taxonomy**

Introduction to microbial taxonomy – morphological , biochemical, molecular taxonomy - Basic concepts of numerical taxonomy - Positive and negative aspects of each taxonomical methods - Morphological phylogeny.

**Unit II - Biochemical and molecular taxonomy**

Chemotaxonomy - fatty acid - protein finger printing - Isozyme typing - pigments and polyamines - Biochemical phylogeny - Molecular taxonomy: G +C content, DNA –DNA hybridization, Plasmid profiles - RFLP - RAPD – STRR – LTRR - REP - PCR , rRNA based DNA finger printing methods

**Unit III – Ribosomal based finger printing**

Types of rRNA: 23s rRNA, 16S rRNA and 5S rRNA - Isolation of DNA - amplification of 16S rDNA using PCR technique - Sequencing of 23s rRNA, 16S rRNA and 5S rRNA - Importance of 16S rRNA in identification of prokaryotes - Methods of 16S rRNA / rDNA fingerprinting.

## Unit IV - Sequence analysis

Submission of rDNA sequences in GenBank – Bankit and Sequin guidelines – NCBI, EMBL and DDBJ – retrieving sequences - RNA structure prediction - Restriction enzyme patterns - Ribosomal Database Project - Designing primers and probes -DNA sequencing- Sequence comparison, alignment and data base searching – ClustalW - Phylip - FASTA and BLAST - DNA barcoding.

## Unit V - Molecular phylogeny

Introduction to Molecular phylogeny – tree terminology - software programs for making phylogenetic trees – MEGA - Phylip, RAPDistance – Cladogram - additive trees and ultrametric trees, rooted, unrooted trees and tree shapes.

### Text Book:

1. Sandy B Primrose and Richard M Twyman. Principles of Genome Analysis and Genomics, Blackwell Publishing, USA. 2005.

### Reference Books:

1. Anna Tromontano. Introduction to Bioinformatics, CRC Press, Florida, USA. 2002.
2. Baxavanis and Oullette. Bioinformatics. A practical Guide to the Analysis of gene and proteins, 3rd edition. John Wiley and Sons, New York.2005.
3. Brendan Wren and Nick Dorrell. Functional Microbial Genomics (Volume 33) (Methods in Microbiology), Academic Press, UK. 2002.
4. Higgins. Bioinformatics: Sequence structure and data banks: A practical approach, Blackwell Publishers, UK. 2005.
5. Perry JJ, Staley JT and Lory S. Microbial Life. Sinauer Associates, Publishers, Sunderland, Massachusetts. 2002.

Total Topics	Local	Regional	National	Global
46	10	3	17	16

Green - Local    Pink - Regional    Blue - National    Brown - Global

## SEMESTER – IV

### CORE COURSE IX – BIOPRODUCTS TECHNOLOGY

**Course Code: 18PMB4CC9**

**Hours: 5**

**Credit: 5**

**Total Marks: 100**

**External Marks: 75**

**Internal Marks: 25**

### Objectives

- To study the industrial important microorganisms and their large scale productions
- To learn the fermentation (FMN) technology and applied this to both large and small scale level
- To learn the up-stream and down-stream process of FMN
- To learn the production of bioproducts through fermentation method by fermenter

### Unit I - Introduction

Basics of Industrial Microbiology: Historical account of microbes in industrial microbiology - sources and characters of industrially important microbes - their isolation - purification and maintenance - Screening of useful strains - primary screening and secondary screening - Strain improvement through random mutation and genetic engineering.

## Unit II - Fermenters

Fermenters – Basic functions - design and components – asepsis and containment requirements – body construction and temperature control – aeration and agitation systems – sterilization of fermenter - air supply, and medium - aseptic inoculation methods – sampling methods, valve systems – a brief idea on monitoring and control devices - types of fermenters – An overview of up-stream and down-stream process.

## Unit III - Fermentations

Fermentation in batch - fed-batch - continuous culture - Microbial growth kinetics - measurement of growth (cell number, direct and indirect methods) growth and nutrient - growth and product formation - heat evolution - effect of environment (temperature, pH, high nutrient concentration) - media formulation – Sterilization - kinetics of thermal death of micro-organisms - batch and continuous sterilization. (All in relation to fermentation).

## Unit IV - Fermented Microbial products I

Fermented Microbial products: Microbial production of Primary - secondary metabolites - Commercial production of antibiotics with special reference to penicillin - streptomycin - Large scale production of recombinant molecules interferon - insulin - vaccines - Attenuated – Non attenuated vaccine.

## Unit V - Fermented Microbial products II

Fermented Microbial products: Microbiology and production of alcoholic beverages - Commercial production of citric and gluconic acids - Commercial production of important amino acids (glutamic acid and lysine) - vitamin (riboflavin) - enzymes (amylase and proteases) - biopolymer (bioplastics).

### Text Book:

1. Waites, M.J., Morgan, N.L., Rockey, J.S. and Higton, G. (2002). Industrial Microbiology: An Introduction. Blackwell Science Publishers

### Reference Books:

1. Nduka Okafor (2007). Modern Industrial Microbiology and Biotechnology. 1<sup>st</sup> Edition: Science Publishers.
2. Stanbury, P.F., Whitaker, A. and Hall, S.J. Principles of Fermentation Technology, Pergamon Press.
3. Demain, A.L. and Davies, J.E. (1999). Manual of Industrial Microbiology and Biotechnology. ASM Press.

Total Topics	Local	Regional	National	Global
47	0	0	20	27

Green - Local    Pink - Regional    Blue - National    Brown - Global

## SEMESTER – IV

### CORE COURSE X – ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY

**Course Code: 18PMB4CC10**

**Hours: 5**

**Credit: 5**

**Total Marks: 100**

**External Marks: 75**

**Internal Marks: 25**

### Objectives

- To understand the role of microbes in soil and agricultural environment
- To know about the bio-inoculants
- To study the soil, aquatic and air microorganisms and its applications

## Unit I – Microbial ecology

Microbial ecology: Interaction between abiotic and biotic factors in an ecosystem - ecological niche - limiting factor - concept of community - fluctuation and succession - Ecological pyramid - energy flow, food chain, food webs and their dynamism - stability and complexity of ecosystem - Interactions between microbes: commensalism, mutualism, parasitism and predation with examples - Microbial communities: Microenvironment and niche, communities in soil, water, air - Biofilms, microbial mats – their significance.

## Unit II – Air and Aquatic microbiology

Aerobiology: Significance of air microflora - Microbial air pollution, sources, Enumeration of bacteria from air - Air sampling devices - Airborne diseases (Bacteria) - Air sanitation.

Aquatic Microbiology: The aquatic environment: major environmental conditions influencing microflora - Distribution of microorganisms in the aquatic environments - freshwater environment, estuaries and marine environment - Microbiology of drinking water, water pollution - purification of water for human consumption - Assessment of microbial status in water and waste water , Waste water treatment.

## Unit III – Soil and plant microbiology

Soil Microbiology: Roles of microbes in biogeochemical cycles – carbon, nitrogen, phosphorus, sulphur. Soil microbes and fertility of soil - Nitrogen fixation: Biochemistry of Nitrogen fixation - mechanism of nitrogenase, hydrogenase, Assay of nitrogen fixation - physiology of legume root nodule, leghaemoglobin – Synthesis - Genes involved in nitrogen fixation.

## Unit IV – Waste management and bioremediation

Recycling of Liquid and Solid wastes: Composting - Solid waste treatment - saccharification and pyrolysis - Liquid waste treatment - Bioremediation: Factors affecting the bioremediation process, Bioremediation of toxic waste sites - Role of microbes - Microbial degradation of environmental pollutants- industrial solvents – pesticides - petroleum hydrocarbons - xenobiotics - Bioremediation practices and technologies.

## Unit V – Bio-inoculants

Biofertilizers: Bacterial bio fertilizer: *Rhizobium*, *Azotobacter*, *Azospirillum* , *Acetobacter diazotrophicus* , phosphobacteria and Frankia - PSM - Algal fertilizer: Blue green algae - Azolla – Importance - Fungal fertilizers: Mycorrhizae, ecto and endomycorrhiza - Biopesticides – Bioinsecticides.

### Text Book:

1. Mohapatra P. K. Textbook of Environmental Microbiology. IK International Pvt. Ltd.

### Reference Books:

1. Atlas Ronald, M., Bartha, and Richard (1987). Microbial Ecology 2<sup>nd</sup> Edition. Cummings Publishing Company.
2. Dirk, J. Elsas, V., Trevors, J.T., Wellington, E.M.H. (1997). Modern Soil Microbiology, Marcel Dekker INC, NY
3. Mitchel, R. (1992). Environmental Microbiology. Wiley – John Wiley and Sons. New York.
4. Prabhakaran, G. 2004. Introduction to Soil and Agricultural Microbiology, Himalaya Publishing House.
5. George N. Agrios. 2005. Plant Pathology. 5<sup>th</sup> Edition. Academic Press.

6. Hand Book Of Biofertilizers & Vermiculture, Engineers India Research Inc., Jan (2007)-332 pages.
7. Raina M. Maier, Ian A. Pepper and Charles Gerba (2009) Environmental Microbiology. Academic Press.

Total Topics	Local	Regional	National	Global
47	1	0	7	39

Green - Local    Pink - Regional    Blue - National    Brown - Global

**SEMESTER – IV**  
**CORE PRACTICAL IV – BIOPRODUCTS TECHNOLOGY & ENVIRONMENTAL  
AND AGRICULTURAL MICROBIOLOGY**

**Course Code: 18PMB4CP4**

**Hours: 8**

**Credit: 4**

**Total Marks: 100**

**External Marks: 60**

**Internal Marks: 40**

**Objectives**

- To learn principles, functions and simple operating procedures of fermentation techniques
- To know what types of microorganisms are found in air, terrestrial and aquatic environments
- To provide a sound background in microbial processes and their applications in agriculture
- To provide information on ecological relationship among soil microorganisms

**Bioproducts technology**

1. Immobilization technique (sodium alginate method)
2. Production, quantification, extraction and characterization of followings: Alcohol
3. Citric acid
4. Amylase
5. Design of various types of fermentors & bioreactors
6. Production of ethanol & wine from grapes and wheat flour

**Environmental, Agricultural and Soil Microbiology**

6. Isolation of Rhizobium from legume nodule
7. Cyanobacteria from water
8. Fungi from molting leaves
9. *Xanthomonas malvacearum* from infected cotton plants
10. Mycorrhizae in infected plant root
11. Water analysis by MPN technique
12. Microbial assessment of air quality – open plate method and air sampler-technique
13. Isolation and counting of faecal bacteria from water and soil
14. Soil Analysis – Physicochemical analysis
15. Cellulase reduction test

**Text Book:**

1. Demain, A.L. and Davies, J.E. (1999). Manual of Industrial Microbiology and Biotechnology. ASM Press

**Reference Books:**

1. Ward, O.P. 1989. Fermentation Biotechnology: Principles, Processes and products. Prentice Hall Engle wood Cliff..
2. Peppier, H,J and Prelman, D.1979. Microbial tech & Fermentation tech.. Vol.1 and II. Academic Press. NY.
3. Rangaswamy, G. and Bagyaraj, D.J. (2001). Agricultural Microbiology, 2nd Ed. Prentice Hall of India Pvt. Ltd.
4. Russell F. Bey. (2001). Microbiology Laboratory Manual, BROOKS/COLE, Australia. Schaechter, M. Medoff, G. and

5. Subba Rao, N.S. (2002). Soil Microbiology, 4th Ed. (soil Microorganisms and plant growth), Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

Total Topics	Local	Regional	National	Global
16	10	3	2	1

Green - Local    Pink - Regional    Blue - National    Brown - Global

## SEMESTER – IV ELECTIVE COURSE V – MARINE MICROBIOLOGY

**Course Code: 18PMB4EC5:1**  
**Hours: 5**  
**Credit: 4**

**Total Marks: 100**  
**External Marks: 75**  
**Internal Marks: 25**

### Objectives

- To understand the microorganisms role in coastal zone environment
- To learn the marine microbial products and their negative impacts on living things
- To provide the knowledge about microbial interactions in marine environment

### Unit I - Introduction of Microbial Oceanography

Introduction to Microbial Oceanography – marine ecosystem: benthic & littoral zone, saltpan, mangroves, sea grasses and estuarine microbes, microbial loop - marine microbial communities - phytoplankton, protozoa, bacteria, fungi, and virus - Microbial endosymbionts – epiphytes - coral-microbial association, sponge - microbial association.

### Unit II – Dynamics of Marine Microbes

Dynamics of Marine Microbes - Carbon cycle: Phototrophic microbes, the oceanic carbonate system and global warming - Nitrogen cycle: Nitrogen fixers – Iron limitation – ocean fertilization - phosphorus cycle - Decomposition of organic matter - Bioleaching and biodeterioration of natural and synthetic materials - Algal blooms.

### Unit III – Microbial Products

Microbial products: Microbial interaction Microbes of Biotechnological importance - Primary - secondary metabolites – enzymes - antibiotics - organic acid – toxins - biosurfactants and pigments.

### Unit IV – Microbes of extreme environments

Microbes of extreme environments – mechanism of extremophiles – halophiles – halorhodopsin – deep sea microbes – microbes of hydrothermal vents - thermophilic, alkalophilic, asomophilic and barophilic, psychrophilic microorganisms – hyperthermophiles and halophiles – importance in biotechnology.

### Unit V – Seafood Microbiology

Seafood microbiology - normal genera associated with fish, food spoilage, fish & human pathogens; zoonotics – Brief account on aquaculture pathogens - Vibriosis – shrimp diseases – WSSV – MBV - Rapid diagnosis of contamination in sea foods – Protection of sea foods- Spoilage of Sea foods - aquaculture products.

**Text Book:**

1. James W. Nybakker (2001). Marine Biology, Benjamin Cummings

**Reference Books:**

1. Rheinheimer, G., 1980. Aquatic Microbiology, Johnwiley & Sons, pp. 235.
2. Elay, A.R.1992. Microbial food poisoning. Chapman and Hall, London, 191 pp.
3. Ford, T.E., 1993. Aquatic microbiology. An ecological approach. Blackwell scientificpublications,London, 518 pp.
4. Krichman, D.L., 2000. Microbial ecology of the oceans. Wiley – liss, New york, 542 pp
5. Bhakuni, D.S. and Rawat, D.S. (2005). Bioactive marine natural products. Anamaya Publishers, New Delhi.

Total Topics	Local	Regional	National	Global
45	1	1	9	37

Green - Local    Pink - Regional    Blue - National    Brown - Global

**SEMESTER – IV**

**ELECTIVE COURSE V – CLINICAL LABORATORY TECHNOLOGY**

**Course Code: 18PMB4EC5:2**

**Hours: 5**

**Credit: 4**

**Total Marks: 100**

**External Marks: 75**

**Internal Marks: 25**

**Objectives**

- To learn the basic knowledge about microbial taxonomy and phylogeny
- To gain the knowledge about advanced microbial identification studies

**Unit I - Laboratory**

Professional conduct - code of behavior - staff health - safety and immunization - Reception, Labeling and Disposal of specimen and culture - Laboratory hazards and safety - First aid - Quality control in laboratory works.

**Unit II - Clinical Pathology**

Urine analysis: Physical, chemical and microscopic examination - specific gravity - Test for albumin –acetone - bile salt and pigments - phosphate, urobilinogen, occult blood and urine deposits - Stool and Sputum analysis - Physical, chemical - microscopic examination (protozoa, helminthes) - Examination of body fluids - CS, acidic and plural, hydrated fluids.

**Unit III - Hematology**

Anaemia – definition - types - investigation - Enumeration and investigation of RBCs - WBCs and Platelets - Blood coagulation and disorder - ESR determination.

**Unit IV - Blood Banking and Serology**

Blood and Rh grouping - blood and plasma collection - screening and storage - safe transfusion of blood cross matching - Quality control - blood donation program - donor motivation and screening - Serology: WIDAL – VDRL - RPR - ELISA tests.

**Unit V - Clinical Microbiology and Biochemistry**

Isolation and identification of microbes from clinical specimens - typhoid and bacillary dysentery - Antibiotic sensitivity test - Estimation of sugar from blood and urine - GCT - Estimation of Proteins - Cholesterol from blood.

**Text Book:**

1. Barbara H Estridge and Anna P Reynolds. Basic clinical laboratory techniques 5th edition,

Cengage learning publisher. 2011.

**Reference Books:**

1. Rafi MD. Textbook of Biochemistry for medical students, 2nd edition, Universities Press, Pvt. Ltd, Hyderabad, India. 2014.
2. Ramnik Sood. Medical lab technology (methods and interpretations-sets of 2vols), Jaypee brothers. 2009.
3. Kanai L Mukherjee. Medical laboratory technology (Procedure manual for routine diagnostic tests-Vol: 1), McGraw Hill Education India Pvt. Ltd. 2010.
4. Robert H Carman. Handbook of CMAI medical laboratory technology-3rd edition), Christian medical association of India. 2011.
5. Ramnik Sood. Concise book of medical laboratory technology (methods and interpretations-2nd edition). Jaypee brothers. 2014.

Total Topics	Local	Regional	National	Global
45	1	4	2	38

Green - Local    Pink - Regional    Blue - National    Brown - Global



HANTHAI HANS ROEVER COLLEGE(AUTONOMOUS), ELAMBALUR, PERAMBALUR

**M.Phil Microbiology (FT/PT) Programme**



(For the candidates admitted from the academic year 2018-2019 onwards)

Semester	Course	Course Code	Title of the Course	Ins. Hours/ Weeks	Credit	Exam Hours	CIA (Max)	ESE (Max)	Total (Max)
I	Core Course – I	18MPMB1CC1	Research Methodology	6	4	3	25	75	100
	Core Course – II	18MPMB1CC2	Advanced Microbiology	6	4	3	25	75	100
	Core Course – III	18MPMB1CC3	Teaching and learning skills	6	4	3	25	75	100
	Core Course – IV	18MPMB1CC4	Paper on Topic of Research (The syllabus will be prepared by the Guide and the examination will be conducted by the COE)	6	4	3	25	75	100
				Total		<b>16</b>			
II	----	18MPMB2DW	Dissertation and Viva-Voce Viva Voce 50 marks Dissertation 150 marks		8				200
			Total		<b>8</b>				<b>200</b>
			Grand Total		<b>24</b>				<b>600</b>

**SEMESTER – I**  
**CORE COURSE I - RESEARCH METHODOLOGY**

**Course Code: 18MPMB1CC1**  
**Hours: 6**  
**Credit: 4**

**Total Marks: 100**  
**External Marks: 75**  
**Internal Marks: 25**

**Objectives**

- To learn the writing of scientific articles
- Importance of the advanced instruments and their simple operating procedure (SOP)
- To gain the knowledge on modern molecular techniques

**Unit I – Introduction of Research**

Research: Types- research process and steps in it- hypothesis - research proposals and aspects- Research design: need- problem definition- sampling procedures- variables- research design concepts- literature survey and review- research design process- errors in research- Research modeling: Types of models- model building and stages- data consideration and testing- heuristic and simulation modeling- Report writing: Pre-writing considerations- thesis writing, formats of report writing- formats of publications in research journals – JCI – impact factor - h-index.

**Unit II - Design of Experiments**

Design of experiments: Objectives- strategies, factorial experimental design- designing engineering experiments- basic principles - replication, randomization, blocking - guidelines for design of experiments- Single factor experiment: Hypothesis testing- analysis of variance components (ANOVA) for fixed effect model - Total treatment and error of squares- degrees of freedom - confidence interval - ANOVA for random effects model- estimation of variance components- model adequacy checking - Two factor factorial design- basic definitions and principles- main effect and interaction- response surface and contour plots- general arrangement for a two-factor factorial design; Models effects - means and regression- hypothesis testing.

**Unit III – Advanced instrumentations**

GC-MS - HPLC – NMR- Fluorescence- Atomic Absorption- CD- ORD- Mass- Raman Spectroscopy – PFGE – MALDI-ToF, TEM and SEM

**Unit IV- Molecular and in-silico techniques**

Denaturing Gradient Gel Electrophoresis (DGGE)- Terminal Restriction Fragment Length Polymorphism (T-RFLP)- Amplified Ribosomal DNA and Restriction Analysis (ARDRA) - Microbial sequence analysis Preparation of ordered cosmid libraries - bacterial artificial chromosomal libraries , shotgun libraries and sequencing - conventional sequencing (Sanger, Maxam and Gilbert Methods) - homology algorithms (BLAST) for proteins and nucleic acids -

open reading frames, annotations of genes - conserved protein motifs related structure / function (PROSITE, PFAM, Profile Scan) - DNA analyses for repeats (Direct and inverted)- palindromes- folding programmes - Use of Internet, public domain databases for nucleic acid and protein sequences (EMBL, GeneBank) - database for protein structure (PDB).

**Unit V – Biosafety and IPR**

Biosafety levels – IBC – Institutional ethical committees – Good Laboratory Practices and Good Manufacturing Practices – regulations on rDNA products - commercialization – copy right, trademark, designs ,royalty - Intellectual Property Rights and patent law – patent laws in India - WTO – Trade related aspects of Intellectual Property Rights ,Patents – conditions for patentability – composition of a patent – patenting of microorganisms – Ethics in science reporting - Reproduction of published material – Plagiarism - Citation and acknowledgement.

**Text Book:**

1. Gurumani, N. (2007). Research Methodology. MJP Publishers, Chennai – 600 005.

**Reference Books:**

1. Krishnamurthy, K.V (2007) Scientometrics. BDU Journal of Science & Technology Vol.I (2) 153 – 168.
2. John G Webster (2004).Bioinstrumentation .Student edition, John Wiley &sons, Ltd.
3. Keith Wilson& John Walker (2003) Practical Biochemistry Principles-tech.5th edition, Cambridge university press.
4. Montgomery, Douglas C. & Runger, George C. (2007), 3/e, Applied Statistics & Probability for Engineers (Wiley)
5. Manual of patent practice and procedure. IPR India, 2005. Ministry of commerce and industry, New Delhi, pp.163.
6. Biotechnology and safety assessment, John.A.Thomas, 2004. pp.333

Total topics	Local	Regional	National	Global
81	0	0	17	64

Green - Local    Pink - Regional    Blue - National    Brown - Global

**SEMESTER – I**  
**CORE COURSE II - ADVANCED MICROBIOLOGY**

**Course Code: 18MPMB1CC2**  
**Hours: 6**  
**Credit: 4**

**Total Marks: 100**  
**External Marks: 75**  
**Internal Marks: 25**

**Objectives**

- To learn the genomics and their applications
- To provide a detailed knowledge of drug designing and microbial nanotechnology
- To understand the basic concepts of in-silico methods

**Unit I - Microbial Technology**

Production of useful products through microbial - recombinant microbes – insulin – vaccines - antibiotics - SCP (Spirulina & Mushroom) - Biofertilizers (Cyanobacteria, Azospirillum & VAM) - Biodegradation of organic wastes - xenobiotic compounds – heavy metals, pesticides, insecticides - Microbial leachin- Microbial Biofuels - hydrogen production - Biodiesel - biodegradation of oils and petroleum products.

**Unit II – Genomics and metagenomics**

**Genomics:** Historical prospective and strategies of genomics - Genome Structure - genome sizes – microbial and organelle genome – genome physical mapping and sequencing – tools in genome analysis - Structural and functional annotations of genes and genomes - Human, plant, animal and microbial genomes - Human Microbiome project - **Metagenomics** – definition , principles ,

methods - whole genome shotgun sequencing – pyrosequencing – metagenomic library production – high throughput screening - Environmental Gene Tags (EGTs).

### Unit III – Proteomics

Proteome - Primary attributes for protein identification - protein species of origin - Protein N- and C-terminal sequence tags - cross species protein identification - Modifications that influence protein change on 2-D PAGE - Detection and analysis of co translational - post-translational modification – Applications of proteomics

### Unit IV – Drug designing

Sources of Drugs - History of drug design - microbial drugs - *E. coli* as a source of recombinant therapeutic proteins - Expression of recombinant proteins in yeasts, animal cell culture systems - Additional production systems - Fungal production systems, transgenic animals, transgenic plants and Insect cell-based systems - Drug development process - Impact of genomics and related technologies upon drug discovery - Gene chips – Proteomics - Structural genomics and Pharmacogenetics - Drug manufacturing process - Guides to good manufacturing practice - Production of final product - Cell banking systems - Upstream processing - Microbial cell fermentation - Downstream processing.

### Unit V - Microbial nanotechnology

Microbial nanotechnology – History, microbial synthesis of Nanoparticles - Synthesis of nanodrugs – metal nanoparticles and drug delivery vehicles – Nanoshells – Tectodentrimers - Nanoparticle drug systems – Diagnostic applications of nanotechnology - Preparation of nanobiomaterials – Polymeric scaffolds collagen - Elastins - Mucopolysaccharides, proteoglycans - cellulose and derivatives - Dextrans; Alginates; Pectins - Chitin - Nanoparticles – types, functions – Silver, Gold and Titanium - Physical and chemical properties of nanoparticles.

#### Text Book:

1. Doolittle RF. (1990). Molecular evolution. Computer Analysis of Protein and Nucleic acid Sequences Methods in Enzymology. Academic Press, New York.

#### Reference Books:

1. Glick BR, Pasternak JJ (1998) Molecular Biotechnology - Principles and Applications of Recombinant DNA, ASM Press, Washington DC
2. Baxevanis AD and BFF Ouellette, Wiley O. (ed) (2001) Bioinformatics – A practical guide to the analysis of genes and proteins. Interscience, New York,
3. Povl Krogsgaard-Larsen, Ulf Madsen and Kristian Stromgaard. Textbook of Drug Design and Discovery, Fourth Edition, CRC press, 2009.
4. Primrose, Principles of Genome analysis. Blackwell Sciences.2003.

Total topics	Local	Regional	National	Global
74	03	02	40	29

Green - Local    Pink - Regional    Blue - National    Brown - Global

## **SEMESTER - I**

Course Code: **18MPMB1CC3**

Credits: 4

Exam Hours: 3

Internal Marks: 25

External Marks: 75

### **Core Course III- TEACHING AND LEARNING SKILLS**

#### **Course Outcomes:**

- Acquaint different parts of computer system and their functions
- Understand the operations and use of computers and common accessories
- develop skills of ICT and apply them in teaching learning context and Research
- appreciate the role of ICT in teaching, learning and Research
- acquire the knowledge of communication skill with special reference to its elements, types, development and styles

- understand the terms communication Technology and Computermediated teaching and develop multimedia/E-content in their respective subject

### **Unit I: Computer Applications Skills**

Computer System: Characteristics, Parts and their functions -Different generations of computer – Operation of Computer: switching on/off/restart.Mouse control, Use of key board and some functions of key – Information and Communication Technology (ICT): Definition,Meaning, Features,Trends – Integration of ICT in teaching and learning – ICT applications: Using word processors, Spread sheets, Power point slides in the classroom –ICT for Research: On-line journals, e-books, Courseware, Tutorials, Technical reports, Theses and Dissertations.

### **Unit II: Communication Skills**

Communication Definitions – Elements of Communication: Sender, Message, Channel, Receiver, Feedback and Noise – Types of Communication: Spoken and Written: Non-verbal Communication – Intrapersonal, Interpersonal, Group and Mass communication – Barriersto communication: Mechanical, Physical, Linguistic & Cultural – Skills of Communication:Listening, Speaking, Reading and writing– Methods of developing fluency in oral and written communication – Style,Diction and Vocabulary – Classroom communication and dynamics.

### **Unit III: Communication Technology**

Communication Technology: Bases, Trends and Developments – Skills of using Communication Technology – Computer Mediated Teaching Multimedia, E – content –Satellite – based communication: EDUSAT and ETV Channels.Communication throughweb:AudioandVideoapplicationsontheinternet,interpersonalcommunicationthrough the web.

### **Unit IV: Pedagogy**

Instructional Technology: Definition,Objectives and Types – Difference between Teachingand Instruction – Lecture Technique: Steps, Planning of a Lecture, Delivery of a Lecture –Narration in tune with the nature of different disciplines – Lecture with power point presentation – Versatility of Lecturetechnique – Demonstration: Characteristics, Principles, PlanningImplementationandEvaluation–Teaching–learningTechniques:Team Teaching,Groupdiscussion,Seminar,Workshop,SymposiumandPanelDiscussion–Modes of teaching: CAI,CMI and WBI

### **Unit V: Teaching Skills**

Teaching Skill: Definition, Meaning and Nature: Types of Teaching skills: Skill of Set induction, Skill of Stimulus Variation, Skill of Explaining, Skill of Probing Questions, Skill of Black Board Writing and Skill of Closure – Integration of Teaching Skills – Evaluation of Teaching Skills.

**References:**

Bela Rani Sharma (2007), Curriculum Reforms and Teaching Methods, Sarup and Sons, New Delhi  
 Information and Communication Technology in Education: A Curriculum for schools and programme of Teacher development, Jonathan Anderson and Tom Van Weert, UNESCO, 2002

Kumar, K.L. (2008) Educational Technology, New Age International Publishers, New Delhi

Mangal, S.K. (2002) Essential of Teaching – Learning and Information Technology, Tandon Publications, Ludhiana

Singh V.K. and Sudarshan, K.N. (1996) Computer Education, Discovery Publishing Company, New York

Sharma, R.A. (2006) Fundamentals of Educational Technology, Surya Publications, Meerut

Vanaja, M. and Rajasekar, S (2006), Computer Education, Neelkamal Publications, Hyderabad

Total topics	Local	Regional	National	Global
71	16	32	25	22

Green - Local    Pink - Regional    Blue - National    Brown - Global

## SEMESTER-I

Course Code: 18MPMB1CC4  
Credits: 4

Exam Hours: 3  
Internal Marks: 25  
External Marks: 75

### COURSE 4 – INDUSTRIAL MICROBIOLOGY

#### Objectives:

- Acquaint basics of industrial microbiology
- To learn the screening of industrial strains, fermenters
- Acquire the knowledge of fermented microbial products

#### Course Outcomes:

- Develop skills of detection and assay of fermented products
- Learners would understand the design, function and components of fermenter.
- Acquire how to recover and purify microbial intracellular and extracellular products
- Enable adequate skills in the manufacture of SCP.
- Scholars would understand the commercial production of antibiotics, enzymes and organic acids.

#### Unit I

**Basics of Industrial microbiology:** Industrially important microbes and their improvement - Screening methods for industrial microbes – detection and assay of fermentation products– classification of fermentation types – strain selection and improvement - Mutation and recombinant DNA techniques for strain improvement - **Preservation of cultures** - **Strain improvement**

#### Unit II

**Fermenter:** Fermenters – Basic functions - design and components – asepsis and containment requirements – body construction and temperature control – aeration and agitation systems – sterilization of fermenter, air supply, and medium - aseptic inoculation methods – sampling methods - valve systems – a brief idea on monitoring and control devices - types of fermenters - Photobioreactor

#### Unit III

**Downstream and upstream process:** Up-stream processes – Strain selection, cultivation - seed preparation - fermentation media - formulation strategies - role of physical and other parameters for microbial growth - types of fermentation - Down-stream processes - The recovery - purification of fermentations products (intracellular and extracellular) - cell disruption – **precipitation** - **filtration**, **centrifugation** - **solvent recovery** – **chromatography** – **ultrafiltration** - **drying**

#### Unit IV

**Industrial Microbial products:** Fermented foods- Milk and dairy products - plant products- Sauerkraut and fermented olives, breads - Microbial cells as food- SCP - **mushroom cultivation** - Source and applications of antioxidants - bio-surfactants - organic acids - **Industrial enzymes production (amylase and proteases)** - **biopolymer (bioplastics)** - **production of antibiotics - penicillin** - streptomycin – interferon - insulin - vaccines.

#### Unit V

**Probiotic technology:** Definition-history-Different terminology- Pre-biotic, **probiotic**, **symbiotic** - Sources of Probiotics - Dairy products, Vegetables, Fruits - Fermented foods- **koozh- yoghurt** - Probiotic strains -Lactic acid bacteria (LAB) - Lactobacillus, Leuconostoc, Lactococcus and Streptococcus -Bacillus -Enterococcus- Mechanism of action - Production of specific substances

(organic acid and bacteriocins) - Competitive adhesion to epithelial receptors - Modification of microbial population - Modulation of immune system - Reduction in inflammation - Aggregation with pathogenic bacteria - Application of probiotics - Enhancement of resistance against pathogens - Stimulation of immune system - Lactose intolerance - Prevention of reduction of constipation - Prevention of diarrhea- Future prospects of probiotics.

## REFERENCES

- 1 Casida LE Jr. Industrial Microbiology, 5th edition, Wiley Eastern Ltd., New Delhi. 1993
- 2 Crueger W and Crueger A. Biotechnology: A Test Book of Industrial Microbiology, 2nd edition. Panima Publishing corporation, New Delhi. 2000.
- 3 Glazer NA and Nikaido H. Microbial Biotechnology: Fundamentals of Applied Microbiology 2nd edition, Cambridge University Press. 2007.
- 4 Pandey A, Soccol RC and Larroche C. Current Developments in Solid-state Fermentation. Springer Verlag. 2008.
- 5 Patel AH. Industrial microbiology. Published by Mac Millan India Ltd., Chennai. 2005.
- 6 Pepler HJ and Pearlman D. Microbial Technology – Fermentation Technology. Vol.1 and 2, 2nd edition, Academic Press, London. 2004.
- 7 Prescott LM, Harley JP and Helin DA, Microbiology, fifth edition, McGraw Hill, New Delhi. 2002. International Publishers, New Delhi
- 8 Sivakumar PK, Joe MM and Sukesh K. An introduction to Industrial Microbiology. First edition, S. Chand and Company Ltd, New Delhi. 2010.
- 9 Stanbury PF, Whitaker A and Hall SJ. Principles of Fermentation Technology, second edition, Aditya Book (p) Ltd., New Delhi. 1999.
- 10 Susan SC and Terry F (2009). Handbook of Prebiotics and Probiotics Ingredients: Health Benefits and Food Applications, CRC Press Publisher.
- 11 Wolfgang K and Seppo S (2011). Probiotics and Health Claims, John Wiley and Sons Publication.

Total topics	Local	Regional	National	Global
84	10	06	44	24

Green - Local    Pink - Regional    Blue - National    Brown - Global