

# **Sadakathullah Appa College**

**(Autonomous)**

**(Reaccredited by NAAC at an 'A' Grade and ISO 9001:2015 Certified Institution)**

**Rahmath Nagar, Tirunelveli – 627 011, Tamil Nadu.**

## **PG DEPARTMENT OF MICROBIOLOGY**



### **CBCS SYLLABUS**

**For**

## **M.Sc. Microbiology**

**(Applicable for students admitted in June 2019 and onwards)  
(As per the Resolutions of the Academic Council Meetings  
held on 03-03-2018, 17-10-2018 and 02-03-2019).**

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**POST GRADUATE DEPARTMENT OF MICROBIOLOGY  
CBCS SYLLABUS M.Sc. MICROBIOLOGY (2018 - 2021)  
COURSE STRUCTURE (CBCS)**

**(Applicable for students admitted in June 2019 and onwards)**

<b>I SEMESTER</b>			<b>II SEMESTER</b>		
<b>COURSE</b>	<b>H/W</b>	<b>C</b>	<b>COURSE</b>	<b>H/W</b>	<b>C</b>
DSC 1	6	4	DSC 4	5	4
DSC 2	6	4	DSC 5	5	4
DSC 3	6	4	DSC 6	5	4
DSE 1	4	4	DSE 2	4	4
P-I	4	2	P-III	4	2
P-II	4	2	P-IV	4	2
			IDC-I	3	3
<b>TOTAL</b>	<b>30</b>	<b>20</b>	<b>TOTAL</b>	<b>30</b>	<b>23</b>
<b>III SEMESTER</b>			<b>IV SEMESTER</b>		
DSC 7	5	4	DSC 10	5	4
DSC 8	5	4	DSC 11	5	4
DSC 9	5	4	DSC 12- Project	8	8
DSE 3	4	4	DSE 4	4	4
P-V	4	2	P-VII	4	2
P-VI	4	2			
IDC 2	3	3	P-VIII	4	2
<b>TOTAL</b>	<b>30</b>	<b>23</b>	<b>TOTAL</b>	<b>30</b>	<b>24</b>
<b>I - IV SEMESTER</b>					
MOOC*		2#			

<b>DISTRIBUTION OF HOURS, CREDITS, NO. OF PAPERS, &amp; MARKS</b>				
<b>SUBJECT</b>	<b>HOURS</b>	<b>CREDITS</b>	<b>NO. OF PAPERS</b>	<b>MARKS</b>
DSC THEORY + PROJECT	66	52	12	1200
DSC PRACTICALS	32	16	8	400
DSE	16	16	4	400
IDC	6	6	2	200
MOOC*		2#	1	
<b>TOTAL</b>	<b>120</b>	<b>90+2#</b>	<b>27</b>	<b>2200</b>

**COURSE STRUCTURE**  
**POST GRADUATE DEPARTMENT OF MICROBIOLOGY**  
**CBCS Syllabus – M.Sc., MICROBIOLOGY (2019-20 onwards)**

Sem	P	Title of the Paper	S. Code	H/W	C	Marks		
						I	E	T
I	DSC 1	General Microbiology and Bacteriology	18PCMB11	6	4	25	75	100
	DSC 2	Techniques in Microbiology	18PCMB12	6	4	25	75	100
	DSC 3	Microbial Biochemistry	18PCMB13	6	4	25	75	100
	DSE 1A	Quality Assurance in Microbiology	18PEMB1A	4	4	25	75	100
	DSE 1B	Medical Laboratory Technology	18PEMB1B					
	P-I	Core Microbiology Practicals-I	18PCMB1P1	4	2	40	60	100/2
	P-II	Core Microbiology Practicals-II	18PCMB1P2	4	2	40	60	100/2
II	DSC 4	Virology	18PCMB21	5	4	25	75	100
	DSC 5	Microbial Physiology and Metabolism	18PCMB22	5	4	25	75	100
	DSC 6	Molecular Biology and Genetic Engineering	18PCMB23	5	4	25	75	100
	DSE2A	Agricultural Microbiology	18PEMB2A	4	4	25	75	100
	DSE2B	Nanobiotechnology	18PEMB2B					
	IDC-1	Microbiology and Human Health	18PIMB21	3	3	25	75	100
	P-III	Core Microbiology Practicals-III	18PCMB2P1	4	2	40	60	100/2
	P-IV	Core Microbiology Practicals-IV	18PCMB2P2	4	2	40	60	100/2
III	DSC 7	Medical Microbiology	18PCMB31	5	4	25	75	100
	DSC8	Immunology	18PCMB32	5	4	25	75	100
	DSC9	Bioinformatics and Biostatistics	18PCMB33	5	4	25	75	100
	DSE3A	Pharmaceutical Microbiology	18PEMB3A	4	4	25	75	100
	DSE3B	Biotechnology	18PEMB3B					
	IDC-2	Entrepreneurship in Microbiology	18PIMB31	3	3	25	75	100
	P-V	Core Microbiology Practicals-V	18PCMB3P1	4	2	40	60	100/2
	P-VI	Core Microbiology Practicals-VI	18PCMB3P2	4	2	40	60	100/2
IV	DSC 10	Food Microbiology	18PCMB41	5	4	25	75	100
	DSC 11	Industrial Microbiology	18PCMB42	5	4	25	75	100
	DSC 12	Project	18PCMB43	8	8			100
	DSE4A	Vermitechnology and Mushroom cultivation	18PEMB4A	4	4	25	75	100
	DSE4B	Bioinstrumentation and Research Methodology	18PEMB4B					
	P -VII	Core Microbiology Practicals-VII	18PCMB4P1	4	2	40	60	100/2
	P -VIII	Core Microbiology Practicals-VIII	18PCMB4P2	4	2	40	60	100/2
I-IV		Massive Open Online Course *		-	2 <sup>#</sup>			
			Total	120	90+2 <sup>#</sup>			2200

\* As per the guidelines of the UGC all the UG and the PG students shall enroll for one Massive Open Online Course offered through SWAYAM, NPTEL, etc.

# Two extra credits will be given on completion of the course.

<b>SEMESTER-I</b>			
<b>DSC 1</b>	<b>GENERAL MICROBIOLOGY AND BACTERIOLOGY</b>		<b>18PCMB11</b>
<b>Hrs/Week:6</b>	<b>Hrs/Sem: 6x15= 90</b>	<b>Hrs/Unit: 18</b>	<b>Credits:4</b>

**Unit I:**

Discovery of microbial world - History of Microbiology and contribution of Antonie Von Leeuwenhoek, Joseph Lister, Paul Ehrlich, Edward Jenner, Louis Pasteur, Robert Koch, Martinus Beijerinck, Sergei Winogradsky, Alexander Fleming, Selman Waksman; the Spontaneous generation controversy; Current thoughts on microbial evolution including the origin of life; Scope and relevance of Microbiology.

**Unit II:**

Taxonomy and Classification- Haeckel's, Whittaker's, Carl Woese and Cavalier Smith's concepts of classification; Modern trends in the classification of microbial world including 16S rDNA sequencing, Numerical and molecular taxonomy; Introduction to the Bergey's Manual of Determinative Bacteriology; General characters of major groups of Eubacteria.

**Unit III:**

Morphology and Ultrastructure of Bacteria - Size, Shape and Arrangement of bacteria; Structure and Chemical composition of Cell Wall of gram positive, gram negative bacteria and Archae; Structure, Composition and Function of Cell membrane, Capsule, Flagella, Pili, Gas vesicles, Cytoplasmic matrix, Reserve food materials, Chromosomes, Carboxysomes, Magnetosomes and Phycobilisomes, Nucleoid and Endospores.

**Unit IV:**

Cultivation of bacteria - Aerobic, Anaerobic; Nutritional Types of bacteria, Culture Media, Growth Curve, Generation time, Growth kinetics, Synchronous growth; Batch and Continuous culture; Measurement of growth (biomass, turbidity, dry weight and protein content); Physical and Chemical factors affecting microbial growth; control of microbes by Physical and Chemical agents.

**Unit V:**

General Characters and Classification of Archae; General Characteristics of Methanobacterium, Methanococcus, Methanomicrobium, Methanosarcina, Halobacterium and Thermococcus; Adaptations and role of Archea in the evolution of microbial world. General Characters of Cyanobacteria, Classification of Cyanobacteria, Ultrastructure and reproduction, Economic importance of Cyanobacteria.

**REFERENCE BOOKS :**

1. Talaro K.P. and Talaro A. 2006. Foundations in Microbiology (6<sup>th</sup> Ed.), McGraw-Hill College Dimensi. Willey J., Sherwood L. and Woolverton C. 2007. Prescott/Harley/Klein's Microbiology, McGraw Hill.
2. Wilson K. and Walker J. 2008. Principles and Techniques of Biochemistry and Molecular Biology. 6<sup>th</sup> Ed. Cambridge University Press.
3. Aneja K. R., Jain P. & Aneja R 2008. A text book of basic & applied Microbiology, New Age Int. Publ. New Delhi.
4. Berg J. M., Tymoczko J. L. & Stryer, L. 2007. Biochemistry 6<sup>th</sup> Ed. W.H. Freeman and Company, New York.
5. Nelson D. and Cox M. M. 2009. Principles of Biochemistry 5<sup>th</sup> Ed. W.H. Freeman and Company, New York.
6. Prescott L.M., Harley J.P. and Klein D.A. 2008. Microbiology 7<sup>th</sup> Ed. McGraw Hill, New York
7. Pelczar Jr., M.J., Chan E.C.S. and Kreig, N.R. 1993. Microbiology. McGraw Hill Inc., New York.

<b>SEMESTER-I</b>			
<b>DSC 2</b>	<b>TECHNIQUES IN MICROBIOLOGY</b>		<b>18PCMB12</b>
<b>Hrs/Week:6</b>	<b>Hrs/Sem: 6x15= 90</b>	<b>Hrs/Unit: 18</b>	<b>Credits:4</b>

**Unit I:**

Microscopy & Staining techniques - Basic Principles for the examination of microbes by Light, Dark field, Phase contrast, Confocal, Fluorescent and Electron (transmission and scanning) microscopy, Micrometry. Specimen Preparation and basic Principles of Simple, Gram, Capsule, Endospore, Flagella, Acid fast, Flurochrome staining, Nuclear/ Geimsa's staining.

**Unit II:**

Basic principles and methods of sterilization - Control of microorganisms by Physical methods- Heat, Filtration and Radiation; Chemical methods: Phenolics, Alcohols, Halogens, Heavy metals, Quaternary ammonium compounds, Aldehydes and Sterilizing gases; Evaluation of Antimicrobial agent effectiveness. Principle and functioning of LAF.

**Unit III:**

Basic principles and methods of media preparation- Types of culture media: Simple media, Complex media, Synthetic media, Enriched media, Selective media, Indicator media, Differential media, Anaerobic media; pH and Buffers; Pure culture techniques, Pour plate Spread plate method and Streak plate, Maintenance of Pure culture; Methods of Preservation of various microbes.

**Unit IV:**

Basic Principles and Applications of Spectrophotometry- Beer-Lambert law; Interaction of radiation with matter, Absorption of radiation, Emission of radiation; UV-Vis Spectrophotometry, Flame photometry and atomic absorption Spectrophotometry; Chromatography (Paper, Thin layer, column, gel filtration, ion-exchange and affinity chromatography), GLC, HPLC and FPLC.

**Unit V:**

Miscellaneous Techniques - Principles and Applications of Electrophoresis for Protein and DNA; Iso-electric focusing and 2D gel electrophoresis; Autoradiography, X-Ray diffraction; Centrifugation; Ultracentrifugation; Dialysis, Ultrafiltration; Lyophilization.

**REFERENCE BOOKS:**

1. Wilson K. & Walker J. 2008. Principles and Techniques of Biochemistry and Molecular Biology. 6<sup>th</sup> Ed. Cambridge University Press.
2. Berg J. M., Tymoczko J. L. & Stryer, L. 2007. Biochemistry 6<sup>th</sup> Ed. W.H. Freeman and Company, New York.
3. Nelson D. & Cox M. M. 2009. Principles of Biochemistry 5<sup>th</sup> Ed. W.H. Freeman and Company, New York.
4. Talaro K. P. & Talaro A. 2006. Foundations in Microbiology 6<sup>th</sup> Ed., McGraw-Hill College Dimensi.
5. Potter G. W. H. & Potter G. W. 1995. Analysis of Biological Molecules: An Introduction to Principles, Instrumentation and Techniques, Kluwer Academic Publishers.
6. Willey J., Sherwood L. and Woolverton C. 2007. Prescott/Harley/Klein's Microbiology, McGraw Hill.

<b>SEMESTER-I</b>			
<b>DSC 3</b>	<b>MICROBIAL BIOCHEMISTRY</b>		<b>18PCMB13</b>
<b>Hrs/Week: 6</b>	<b>Hrs/Sem: 6x15= 90</b>	<b>Hrs/Unit: 18</b>	<b>Credits:4</b>

#### **UNIT I**

Carbohydrates - Definition and Classification- Properties- Optical and Chemical Structure of Glucose, Ring structure, Haworth and Fischer's projection, Pyranose, Furanose Isomers, Mutarotation, Triose, Pentose, Hexose, Heptose - Example and Structures, Derived Monosaccharide - Glycosides, Furanoacids, Sugar, Phosphates, Uronic acids, Sugar alcohol, Disaccharides- Glycosidic linkage, Lactose, Maltose, Sucrose, Oligosaccharide, Trisaccharides, Structure of raffinose- Polysaccharide- Homopolysaccharide, Heteropolysaccharide Structure, Starch, Cellulose, Mucopolysaccharide and Biological Significance.

#### **UNIT II**

Lipids- Classification, Chemistry of Fattyacids- Unsaturated, Saturated fatty acids, Triglycerides, Saponification, Sterols, Cholesterol, Prostaglandins, Glycolipids and Functions of lipids.

#### **UNIT III**

Proteins- Classification, Structure of Primary, Secondary, Tertiary and Quarternary Protein, Classification of amino acids, Properties, Peptide bond formation and Types.

#### **UNIT IV**

Nucleic acid - Structure of Nitrogen bases and base pairing, Structure of Nucleosides, Nucleotides, Ribose, Deoxyribose sugar. DNA, RNA Structure, Function, Types and Importance.

#### **UNIT V**

Enzymes- Concept, Definition, Nature, Active site, Properties, Classification, Physico-Chemical properties. Factors affecting the enzyme synthesis and activity. Allosterism – Determination of MichaelisMenten constant – Factors affecting Km Value – Mode of Enzyme action (Lock and Key model and Induced fit model)- Coenzymes – Cofactors – Isozymes and Inhibitors. Vitamins - Water and fat soluble vitamins and functions.

#### **REFERENCE BOOKS:**

1. Stryer, L. 1995. Biochemistry. Ed. W.H. Freeman and company, Newyork.
2. J.L.Jain, Fundamental of Biochemistry- S.Chand & company Ltd, New Delhi.
3. Santhyanarayana. U. 2002. Essentials of Biochemistry. (1<sup>st</sup> Edition) Books and Allied Ltd., Kolkata ,
4. Deb A.C. 1999. Concepts of Biochemistry. (7<sup>th</sup> Ed.), Books and Allied (P)Ltd.,Kolkata
5. Lehninger. 2009. Principle of Biochemistry. 3<sup>rd</sup> editions by Nelson and Cox (Worth).

<b>SEMESTER-I</b>			
<b>DSE 1A</b>	<b>QUALITY ASSURANCE IN MICROBIOLOGY</b>		<b>18PEMB1A</b>
<b>Hrs/Week:4</b>	<b>Hrs/Sem: 4x15= 60</b>	<b>Hrs/Unit: 12</b>	<b>Credits:4</b>

#### **UNIT I**

Good laboratory practices – Management of laboratory hazards and knowledge in First aid procedures. Bioethics – Socio ethical aspects of microbial biotechnology.

#### **UNIT II**

Quality assurance – Introduction and overview – Definition, Designing of microbiology laboratory –Quality Control and its Applications.

#### **UNIT III**

Quality assessment of Equipment, Chemicals, Glass wares and Laboratory environments –Variance – Quality control calculations – Quality management – Maintenance of records and reports.

#### **UNIT IV**

Quality assurance in Sterilization and Disinfection - Preservation of stock cultures, media and diagnostic kits – Quality control of media and stains.

#### **UNIT V**

Quality assessment of Disposal, Decontaminated matters and other biological effluents. Quality management in transportations of cultures. National control of Biological references and standards. Microbial quality control of pharmaceutical products.

#### **REFERENCE BOOKS:**

1. Rajesh Bhatia and Rattan LalChhpujani. 1995. I<sup>st</sup> Ed. “Quality assurance in Microbiology”
2. L.K.Muherjee Medical Lab Technology – 3 Volumes.



<b>SEMESTER-I</b>			
<b>DSE 1B</b>	<b>MEDICAL LABORATORY TECHNOLOGY</b>		<b>18PEMB1B</b>
<b>Hrs/Week: 4</b>	<b>Hrs/Sem: 4x15 = 60</b>	<b>Hrs/Unit: 12</b>	<b>Credits:4</b>

### **UNIT I**

Blood - Composition, Function and Separation of Plasma proteins. Methods of collection of blood – Anticoagulants and its role. Preparation of blood smear and Staining. Estimation of haemoglobin (cymethhaemoglobin method), RBC Count, WBC Count by using Haemocytometer. Differential count using staining procedure. Estimation of ESR, PCV by Wintrobe method. Haemopoiesis, Erthroipoiesis, Leucopoiesis and Thrombopoiesis.

### **UNIT II**

Introduction to Immunoheamotology – Immunologic reaction in blood banking – Blood Components – Introduction Basic principle involved in immunohaemotology. Major and Minor cross matching – Rhesus typing, Coombs test. Forward and reverse grouping

### **UNIT III**

Normal Composition of urine – Routine Examination of Urine – Physical – colour, Odour, pH, Specific gravity, Chemical – Sugar, Protein, Ketone bodies, Bile Salt, Bile Pigments, Microscopy – Casts and Crystals, Pus Cells, RBCs, Epithelial cell, Bacteria, Yeast Cells. Stool – Physical examination of Stool – Consistancy, Colour, Mucus, blood. Chemical – Reducing Substance, Occult blood. Microscopy – Ova and Cysts of *Entamoebahistolytica*, *Giardia*.

### **UNIT IV**

CSF – Normal composition, Examination of CSF proteins, sugar, Microscopical examination for pus cells, Bacteria findings in CSF in common diseases. Semen – Physical Examination of Semen – Volume, Colour, Odour, Viscosity. Chemical examination – pH, Fructose. Microscopy – Sperm count, Motility and Morphology. Clinical Contions – Azoopermia, oligozoopermia. Aspermia, Hypospermia. Teratozoospermia.

### **UNIT V**

Serology- Introduction , WIDAL, RPR, General inflammatory markers – CRP, RA, ASO. Screening Tests – HBs Ag, HIV (ELISA and Western Blot Test) TPHA, Malarial Parasite.

### **REFERENCE BOOKS:**

1. Clinical Diagnosis by Laboratory Examination John A Kokmer.
2. Text Book of Pathology Vol. I & II – N.C. Dey
3. Clinical Laboratory Diagnosis – Levinson S A, Mac Fate R.D.
4. Clinical Lab. Methods & Diagnosis Vol. I & II – Alex C, S. L. Garelt.
5. Clinical Lab. Methods – John D Bengner, Plilip G. Achermann, Gelsaon Toro.

<b>SEMESTER-I</b>		
<b>P-I</b>	<b>CORE MICROBIOLOGY PRACTICALS-I</b>	<b>18PCMB1P1</b>
<b>Hrs/Week:4</b>	<b>Hrs/Sem: 4x15= 60</b>	<b>Credits:2</b>

#### **TECHNIQUES IN MICROBIOLOGY**

1. a) Laboratory Precautions.  
b) Washing and cleaning of glass wares.  
c) Biological safety cabinets.
2. Hay mount to show different types of microbes.
3. Hanging drop technique.
4. Sterilization :  
a) Dry heat  
b) Moist heat  
c) Filtration
5. Staining techniques:  
a) Gram's staining  
b) Acid fast staining  
c) Spore staining  
d) Capsule staining
6. Preparation of culture media.
7. Techniques for pure culture of microorganisms by Serial dilution technique and determination of bacterial numbers:  
a) Pour plate method  
b) Spread plate method  
c) Streak plate method  
d) Enumeration of bacteria – Water and Soil samples
8. Counting of Microbial cells using Haemocytometer.
9. Cultivation of anaerobic microorganisms – Pyrogallol method.
10. Cultivation and morphology of molds – Lacto phenol cotton blue staining.
11. Fungal slide culture – technique.

#### **REFERENCE BOOKS:**

1. Cappuccino.J.G., and Sherman.N.(1996). Microbiology – A Laboratory Manual. Benjamin Cummins. New York.
2. Kannan.N. (1995). Laboratory Manual in General Microbiology. Palani Paramount Publication, Palani.
3. Gunasekaran. P. (1996). Laboratory Manual in Microbiology. New Age International Ltd., Publishers, New Delhi.
4. Sundararaj, T. (2005), Microbiology – Laboratory Manual. (First Edition) Publn. Sundararaj. T, Chennai.
5. Jayaraman, J. (1985). Laboratory Manual in Biochemistry. Wiley Eastern Ltd., New Delhi.
6. Rajan.S.,Selvi Christy. R (2012). Experimental procedure in Life sciences. Anjanaa Book House.

<b>SEMESTER-I</b>		
<b>P -II</b>	<b>CORE MICROBIOLOGY PRACTICALS-II</b>	<b>18PCMB1P2</b>
<b>Hrs/Week:4</b>	<b>Hrs/Sem: 4x15 = 60</b>	<b>Credits:2</b>

#### **TECHNIQUES IN BACTERIOLOGY & BIOCHEMISTRY**

1. Isolation and identification of *Streptococcus sp.*,
2. Isolation and identification of *Bacillus sp.*,
3. Isolation and identification of *E.coli*
4. Isolation and identification of *Pseudomonas sp.*,
5. Examination of Dry weight of bacteria.
6. Estimation of Proteins by Lowry's method.
7. Estimation of Sugar by Anthrone method.
8. Identification of Reducing and Non-reducing Sugar by Benedicts reagent.
9. Estimation of Ascorbic Acid.
10. Separation of amino acid by paper chromatography.
11. Separation of amino acid by thin layer chromatography.
12. Separation of compounds in leaf crude extract by thin layer chromatography.
13. Biochemical tests
  - a) Blood Glucose
  - b) Urea
  - c) Cholesterol

#### **REFERENCE BOOKS:**

1. Sundaraj, T. AswathySundararaj, 2002. Microbiology laboratory manual Chennai.
2. R.C. Dubey &Maheswari, 2002. Practical microbiology S. Chand & Co. Ltd., New Delhi.
3. Cappuccino & Sherman, Microbiology a laboratory manual, 2002. Experiments in Microbiology Plant pathology & Biotechnology, K.R. Aneja, Fourth edition, New age international (p) Limited, Publishers.
4. Kannan. N. 1996. Laboratory Manual in General Microbiology. Palani Paramount Publication, Palani.
5. Kanai L. Mukherjee, Medical Laboratory Technology – A procedure manual for routine diagnosis tests – Tata McGraw – Hill Publishing Co., Ltd., New Delhi. Vol.I-III.
6. Janarathanan& Vincent, 2007. Practical Biotechnology: Methods &Protocols Universities press.
7. Palanivelu, P. 2001. Analytical Biochemistry & Separation Techniques, second edn.

<b>SEMESTER-II</b>			
<b>DSC 4</b>	<b>VIROLOGY</b>		<b>18PCMB21</b>
<b>Hrs/Week:5</b>	<b>Hrs/Sem: 5x15= 75</b>	<b>Hrs/Unit: 15</b>	<b>Credits:4</b>

### **UNIT I**

History and scope of Virology. Viruses – Definitions – Structures – General properties and Classifications. Bacterial Viruses – Introduction – taxonomy of bacterial viruses – DNA containing Viruses – Structure – Replication and Growth kinetics of phages (Lytic and Lysogeny). Filamentous phages – RNA containing viruses – Structure and Replication of TMV.

### **UNIT II**

Animal viruses – RNA viruses – Picorna virus, Herpes virus, Human Papiloma virus, Toga virus. RNA tumor viruses – Retro viruses. DNA viruses – Vaccinia virus, Hepatitis B, DNA tumor viruses – SV 40, Adeno viruses, Swine flu, Bird flu, HIV, Prions.

### **UNIT III**

Plant viruses – RNA viruses, Tobacco Mosaic viruses (TMV), Tobacco necrosis viruses (TNV), Satellite viruses. Double stranded DNA viruses – CaM Viruses, Single stranded DNA viruses – Gemini virus. Quantitative assay, Immunodiagnosis of virus.

### **UNIT IV**

Techniques in virology – Cultivation of viruses – Isolation and Purification of Viruses. Characterization and Enumeration of viruses

### **UNIT V**

Bacteriophage-Introduction - Classification- Types – T Bacteriophage (T4)- Lamba phage- Replication of Bacteriophage- Lytic and Lysogenic cycle- Phage assay- Phage typing

### **REFERENCE BOOKS:**

1. Fields. B.N. Fields, D.M. Knipe, P.M. Howley, R.M. Chanock, J.L. Melnick, T.P. Monath, B. Roizman, and S.E. Straus, Virology Vol 1 and 2 Lippincott-Raven, Philadelphia, PA.
2. Frankel Conrat et al, 1994. Virology, 3rd ed. Prentice Hall.
3. Dimmock et al., 2001. Introduction to Modern Virology, 5th ed. Blackwell Scientific Publ.
4. Waginer and M. Hewlett, 1999. Basic Virology, Blackwell Science Publ.

<b>SEMESTER-II</b>			
<b>DSC 5</b>	<b>MICROBIAL PHYSIOLOGY AND METABOLISM</b>		<b>18PCMB22</b>
<b>Hrs/Week:5</b>	<b>Hrs/Sem: 5x15= 75</b>	<b>Hrs/Unit: 15</b>	<b>Credits:4</b>

**Unit I:**

Nutritional requirements of major groups of microbes (bacteria & fungi): Nutritional uptake; transport across the membranes and cell wall (diffusion, passive diffusion, active transport, group translocation and iron uptake).

**Unit II:**

Respiratory metabolism: Glycolytic pathway of carbohydrates breakdown, Glycolysis, Embden Meyerhoff pathway, Krebs cycle, Entner-Duodoroff pathway, Phosphoketolase pathway; Pentose phosphate pathway; Oxidative and Substrate level phosphorylation, Gluconeogenesis, Glyoxylate cycle, Fermentation of Carbohydrates, Homo and Hetero Lactic fermentation.

**Unit III:**

Microbial metabolism: Anabolism, Catabolism - Biosynthesis of Essential amino acid, Sulphur metabolism, Biosynthesis of purines and pyrimidines.

**Unit IV:**

Photosynthesis: Absorption of light, photosynthetic and accessory pigments (Chlorophyll, Bacteriochlorophyll, Carotenoides, Phycobilliproteins); Oxygenic and Anoxygenic photosynthesis in prokaryotes, Electron transport chain; phosphorylation; Calvin cycle; effect of Light, Temperature, pH and CO<sub>2</sub> on photosynthesis; Photosynthetic yield and Photorespiration.

**Unit V:**

Nitrogen fixation in symbiotic and free living system: oxygen and hydrogen regulation of nitrogen fixation, nitrification, denitrification and ammonifying bacteria, Pathway of nitrate assimilation in photosynthetic and non-photosynthetic systems, transamination and deamination reactions.

**REFERENCE BOOKS:**

1. Berg J. M., Tymoczko J. L. & Stryer, L. 2007. Biochemistry 6<sup>th</sup> Ed. W.H. Freeman and Company, New York.
2. Nelson D. & Cox M. M. 2009. Principles of Biochemistry 5<sup>th</sup> Ed. W.H. Freeman and Company, New York.
3. Talaro K. P. & Talaro A. 2006. Foundations in Microbiology (6<sup>th</sup> Ed.), McGraw-Hill College.
4. Potter G. W. H. & Potter, Geoffrey W. 1995. Analysis of Biological Molecules: An Introduction to Principles, Instrumentation and Techniques, Kluwer Academic Publishers.
5. Willey J., Sherwood L. and Woolverton C. 2007. Prescott/Harley/Klein's Microbiology, McGraw Hill. Atlas R. M. 1997. Principles of Microbiology II Ed., McGraw Hill.

<b>SEMESTER-II</b>			
<b>DSC6</b>	<b>MOLECULAR BIOLOGY AND GENETIC ENGINEERING</b>		<b>18PCMB23</b>
<b>Hrs/Week:5</b>	<b>Hrs/Sem: 5x15= 75</b>	<b>Hrs/Unit: 15</b>	<b>Credits:4</b>

**Unit I:**

DNA Genetic material- Experimental evidences; DNA structure; types of DNA, DNA replication in prokaryotes: steps: initiation, elongation termination. DNA replication in eukaryotes: replication origins & initiation, steps involved, synthesis of telomeric DNA. Types of DNA polymerase involved in prokaryotes and Eukaryotes, Difference in prokaryotic and Eukaryotic DNA replication. Various modes of replication- d-loop replication and rolling circle.

**Unit II:**

Transcription - initiation, elongation & termination, anti-termination. Types of RNA polymerase in prokaryotes and Eukaryotes, Inhibitors of RNA synthesis, Post transcriptional modification-capping, polyadenylation & splicing – spliceosome, Difference between prokaryotic and Eukaryotic transcription. Translation in prokaryotes and eukaryotes; stages in translation, roles of various factors in the translational steps, Post translational modification of proteins, inhibitors of translational process, Genetic code.

**Unit III:**

Gene - Introduction, operon concept - lac operon, trp operon, arabinose operon, Promoters, Repressors. Regulation of Gene Expression – Transcriptional control- promoters, terminators, attenuators, and anti-terminators; induction and repression the lac operon-catabolite repression

**Unit IV:**

Genetic Engineering – Introduction, Mendelian and non mendelian inheritance, Basics of r-DNA technology: Enzymes used in r-DNA technology; DNA ligase, DNA polymerase, reverse transcriptase, exonuclease, endonuclease, terminal deoxynucleotidyltransferase, alkaline phosphatase, polynucleotide kinase, and dephosphatases; restriction modification systems and their types; sticky and blunt end ligation, joining with linkers, adapters & homopolymer tailing.

**Unit V:**

Transformation, transduction- general and specialized, conjugation- Transposable Element- Introduction- Discovery, insertion sequences, complex and compound transposons- Transposons of *E.coli* and yeast

**REFERENCE BOOKS:**

- 1) Maloy 1994. Microbial Genetics. Jones and Bartlett Publishers. Dale J. W. 1994. Molecular Genetics of Bacteria. John Wiley and Sons. Streips and Yasbin 1991. Modern Microbial Genetics. Niley Ltd.
- 2) Watson, J. D. Hoppkins N. H. Roberts J. W. Steitz J. A. & Weiner A. M. 1987. Molecular Biology of the Gene. Benjamin / Cummings Publications Co. Inc. California.
- 3) Lewin 2000. Gene VII. Oxford University Press.
- 4) Friedberg C. Graham C. Walker & Wolfram S. 1995. DNA repair and mutagenesis. ASM Publications.
- 5) Larry S. and Wendy 1997. Molecular Genetics of Bacteria. ASM Publications.
- 6) Nicholl D. S. T. 2008. An Introduction to Genetic Engineering, Cambridge University Press.
- 7) Glick BR, Pasternak J.J. 2003. Molecular Biotechnology. ASM Press Washington D.C.
- 8) Old and Primrose 2001. Principles of Gene Manipulation. Blackwell Scientific Publication.
- 9) Brown T.A. 2006. Gene Cloning. Blackwell Publishing.
- 10) Sambrook J. & Russell D. W. 2001. Molecular cloning- A laboratory manual. Cold Spring Harbor Laboratory Press.

<b>SEMESTER-II</b>			
<b>DSE 2A</b>	<b>AGRICULTURAL MICROBIOLOGY</b>		<b>18PCMB2A</b>
<b>Hrs/Week:4</b>	<b>Hrs/Sem: 4x15 = 60</b>	<b>Hrs/Unit: 12</b>	<b>Credits:4</b>

### UNIT I

Soil – Nature medium for Plant growth, Physical and Chemical Properties of Soil, Soil Structure, Soil Microorganisms- Bacteria, Atinomyces, Fungi, Algae, Protozoa. Methods used in Soil Microbiological Studies.

### UNIT II

Biological Nitrogen fixation- Nitrogen Bacteria (Free living and Symbiotic)- mechanism of nitrogen fixation (biochemistry of nitrogenase) - genetics of nitrogen fixation - Rhizobium-Legume Association - Nitrogen fixation by non-leguminous plants. Nitrogen fixation by free living Blue Green algae, Symbiotic Blue Green algae. Mycorrhizae - Ecto, Endomycorrhizae, Arbuscular Mycorrhizae.

### UNIT III

Microbial Products Influencing Plant Growth - Indoleacetic acid, Gibberellins, Cytokinins, Ethylene, Antibiotics, Aflatoxin. Biofertilizers - (*Rhizobium*, *Azospirillum*, *Azotobacter*, *Cyanobacteria*, *Phosphobacteria* and *Azolla*)-Inoculants, mass production and method of application and its Quality Control (BIS specification). Bacterial and Fungal Insecticides.

### UNIT – IV

Plant Disease- Concepts of Epidemiology, Classification of Plant disease, Development of disease in Plant Population. Monocyclic and Polycyclic Pathogens. Role of environment and meteorological factors in the development of Plant disease epidemics. Management of Plant diseases.

### UNIT – V

Bacterial Diseases of Plants - Soft rot (*Pseudomonas spp*), Corky root (*Rhizomonassuberifaciens*), Bacterial pith necrosis in tomatoes (*Pseudomonasspp*), Common bacterial blight (*Xanthomonasspp*), Black leg (*Erwiniaspp*). Fungal Plant Diseases- Fungal Early blight (*Alternariasolani*), Late blight (*Phytophthora*), Plant Wilting (*Fusariumoxysporum*),

Brown rot (*Fibroporiaspp*), Cotton Ball (*Monilinaoxyocci*), Downy mildew (*Peronosporaeaes*).

#### **REFERENCE BOOKS:**

1. Shiva Aithal, C. (2010). Mordern approaches in Soil, Agricultural and Environmental Microbiology. Himalaya Publishers, New Delhi.
2. Atlas,R.M., and Bartha.M. (2003). Microbial Ecology – Fundamentals and applications. Benjamin – Cummings, Mento Park, California.
3. Martin Alexander (1983). Introduction to Soil Microbiology, Wiley eastern Ltd., NewDelhi.
4. Subba Rao, N.S.(1997). Biofertilizers in Agriculture and Forestry 3<sup>rd</sup> Ed, Oxford and IBH Publishing Co, Pvt. Ltd, NewDelhi.
5. SubbaRao,N.S.(1995). Soil Microorganisms and Plant growth. Ed, Oxford and IBH Publishing Co, Pvt. Ltd, NewDelhi
6. Wheeler, B.E. (1976). An introduction to Plant disease. ELBS and John Wiley and sons, Ltd.
7. Rangaswamy.G., and Bagyaraj.D.J. (1996). Agricultural Microbiology. Prentice- Hall of India Pvt Ltd., New Delhi.
8. Dirk, J. Elases, V., Trevors,.T., and Wellington, E.M.H. (1997). Modern Soil Mirobiology. Marcel Dekker INC, New York, HongKong.
9. Dubey R.C. (2001).A Text Book of Biotechnology. S Chand & Co. New Delhi.
10. Gupta, S.K.(2014). Approaches and trends in plant disease management. Scientific publishers, Jodhpur, India.
11. Jammaluddin et al (2013). Microbes and sustainable plant productivity. Scientific Publishers Jodhpur, India.
12. Purohit, S.S.Kothari, P.R. and Mathur (1993). Basic and Agrcultural Biotechnology, Agrobotanical Publishers (India), Bikaner.



<b>SEMESTER-II</b>			
<b>DSE 2B</b>	<b>NANOBIOTECHNOLOGY</b>		<b>18PCMB2B</b>
<b>Hrs/Week:4</b>	<b>Hrs/Sem: 4x15= 60</b>	<b>Hrs/Unit: 12</b>	<b>Credits:4</b>

### **Unit I**

Nanotechnology: Introduction, History - Important Contributions of Nanotechnology

### **Unit II**

Overview of Nano Fabrication Methods: Top-down and bottom-up approaches, Lithography, Deposition. Characterization Tools: UV spectrophotometer, Scanning Electron Microscope (SEM), Transmission Electron microscope (TEM), Atomic Force Microscope (AFM).

### **Unit III**

Nanoparticles- Definition, Properties, Different types- Nanowire, Nanotubes, Nanocomposite, Nanoshell, Quantum dots

### **Unit IV**

Chemical methods for the synthesis of Nanoparticles- Physical methods for the synthesis of Nanoparticles - Biological synthesis of Nanoparticles preparation using Microorganism - Silver Nanoparticles, Gold Nanoparticles- Nanoparticles synthesis using Plant materials - Silver Nanoparticles, Gold Nanoparticles.

### **Unit V**

Nanomedicine- Introduction- Drug delivery, Cancer therapy, Biomedical sensor, Bioimaging.

### **References Books:**

1. Claudio Nicolini, Nanobiotechnology & Nanobiosciences Pan Stanford Publishing Pte. Ltd, 2009.
2. C.M. Niemeyer and C.A. Mirkin, Nanobiotechnology, Concepts, Applications and perspectives, WILEY-VCH, Verlag GmbH & Co, 2004.
3. S. David Goodsell, Bionanotechnology, Lessons from Nature, Wiley-Liss, Inc, 2004.

<b>SEMESTER-II</b>		
<b>P-III</b>	<b>CORE MICROBIOLOGY PRACTICALS-III</b>	<b>18PCMB2P1</b>
<b>Hrs/Week:4</b>	<b>Hrs/Sem: 4x15= 60</b>	<b>Credits:2</b>

### **TECHNIQUES IN VIROLOGY AND MICROBIAL PHYSIOLOGY**

1. Isolation of Bacteriophage from sewage.
2. Phage Titration.
3. Study of Virus infected Plant (Leaf).
4. Cultivation of Virus- Embronated Egg Method (Demonstration).
5. Bacterial Growth curve (Turbidity method).
6. Biochemical tests for Identification of Bacteria:
  - a) Indole
  - b) Methyl Red
  - c) Voges- Proskauer
  - d) Citrate Utilization
  - e) Triple sugar iron test
  - f) H<sub>2</sub>S test
  - g) Urease test
  - h) Catalase test
  - i) Nitrate reduction
  - j) Oxidase Test
7. Carbohydrate fermentation:
  - a) Glucose
  - b) Lactose
  - c) Sucrose
  - d) Maltose
  - e) Fructose
  - f) Mannitol
8. Production of Extra cellular enzyme by microorganisms:
  - a) Starch hydrolysis
  - b) Casein hydrolysis
  - c) Gelatin hydrolysis
  - d) Lipid hydrolysis

### **REFERENCE BOOKS:**

1. Cappucino J.G, and Sherman .N, 1996 Microbiology –A laboratory Manual
2. Kannan 1996. Laboratory Manual in General Microbiology Palani Paramount Publications, .Palani

<b>SEMESTER-II</b>		
<b>P IV</b>	<b>CORE MICROBIOLOGY PRACTICALS-IV</b>	<b>18PCMB2P2</b>
<b>Hrs/Week:4</b>	<b>Hrs/Sem: 4x15= 60</b>	<b>Credits:2</b>

#### **TECHNIQUES IN MOLECULAR BIOLOGY AND GENETIC ENGINEERING**

1. Isolation of Chromosomal DNA from E.coli.
2. Isolation of Plasmid DNA.
3. Estimation of DNA by Phenylalanine method
4. Estimation of RNA by Orcinol Method
5. Agarose Gel Electrophoresis- DNA Sample.
6. Separation of Protein by SDS- PAGE.
7. Induced Mutagenesis – UV and NTG.
8. PCR (DEMO).
9. Restriction Enzyme digestion of DNA
10. Conjugation
11. Transformation

#### **REFERENCE BOOKS:**

1. Cappucino J.G, and Sherman .N, 1996 Microbiology –A laboratory Manual
2. Kannan 1996. Laboratory Manual in General Microbiology Palani Paramount Publications, Palani.

<b>SEMESTER-III</b>			
<b>DSC 7</b>	<b>MEDICAL MICROBIOLOGY</b>		<b>18PCMB31</b>
<b>Hrs/Week:5</b>	<b>Hrs/Sem: 5x15= 75</b>	<b>Hrs/Unit: 15</b>	<b>Credits:4</b>

#### **Unit I:**

Historical developments in medical microbiology, Normal flora of human body, Role of the resident flora, Collection of clinical samples and laboratory diagnosis of important bacterial infections, Pathogenic microorganisms. Brief account of major air, water and soilborne diseases of microbial origin and their preventive and control measures.

#### **Unit II:**

Bacteriology- Important human diseases caused by *Staphylococcus*, *Streptococcus*, *Pneumococcus*, *Neisseria*, *Bacillus*, *Corynebacterium*, *Clostridium*, *Pseudomonas*, *Yersinia*, *Haemophilus*, *Mycobacterium*, Antibacterial agents and susceptibility test, Bacterial vaccines.

#### **Unit III:**

Virology- Collection of clinical samples and laboratory diagnosis of important viral diseases - Mumps, Measles, Influenza, Adenovirus, Enterovirus, Rhinovirus, Poxvirus, Hepatitis virus; Herpes virus, AIDS, Antiviral drugs, Viral vaccines, Interferons, Tumourviruses, antiviral agents & susceptibility test.

#### **Unit IV:**

Mycology- Classification of medically relevant fungi, Collection of clinical samples and laboratory diagnosis of important human fungal diseases : Candidiasis, Dermatophytosis, Aspergillosis, Otomycosis, Cutaneous and subcutaneous mycoses, Systemic mycoses, Opportunistic mycoses, Antifungal agents (specific to disease to be included in course) & their susceptibility test.

#### **Unit V:**

Parasitology- Important diseases caused by intestinal and urogenital protozoa: *Entamoeba*, *Giardia*, *Trichomonas*. Blood and tissue protozoa; *Plasmodium*, *Trypanosoma*, *Leishmania*, *Cestodes*, *Taenia*, *Trematodes*, *Schistosoma*, *Paragonimus*, Nematodes: *Ascaris*, *Ancylostoma*, *Necator*- laboratory diagnosis, treatment and prevention, antiparasitic agent and susceptibility test.

#### **REFERENCE BOOKS**

1. Greenwood D. 2007. Medical Microbiology 4<sup>th</sup> Ed., I.K. International.
2. Murray P.R., Tenover F.C., & Tenover F.C., & Tenover F.C., & Tenover F.C. 2007. Clinical Microbiology, ASM Press.
3. Talaro K. P. & Talaro A. 2006. Foundations in Microbiology (6th Ed.), McGraw-Hill College. Dimensi.
4. Willey J., Sherwood L. and Woolverton C. 2007. Prescott/Harley/Klein's Microbiology, McGraw Hill.
5. Atlas R. M. 1997. Principles of Microbiology 2<sup>nd</sup> Ed., McGraw Hill.
6. Nester E. W., Anderson D. G. & Nester M. T. 2006. Microbiology: A Human Perspective, McGraw Hill.
7. Harvey, R.A., Champe, P.C. and Fisher, B.D. 2007. Lippincott's Illustrated Reviews : Microbiology.
8. Lippincott Williams and Wilkins, New Delhi/New York.

<b>SEMESTER-III</b>			
<b>DSC 8</b>	<b>IMMUNOLOGY</b>		<b>18PCMB32</b>
<b>Hrs/Week:5</b>	<b>Hrs/Sem: 5x15= 75</b>	<b>Hrs/Unit: 15</b>	<b>Credits:4</b>

**Unit I:**

Introduction to the immune system, Innate immunity- anatomic, physiological, phagocytic & inflammatory barriers. Adaptive immunity- natural & artificial immunity. Cells involved in immune response: lymphoid lineage (producing B & T lymphocytes) & Myeloid lineage (phagocytes: macrophages, neutrophils & eosinophils, Auxillary cells, basophils, mast cells & platelets). Organs involved in immune system: primary & secondary lymphoid organs.

**Unit II:**

Antigens: Preparation of antigens, Types of antigens- Haptens, Super antigens & clusters of differentiation molecules (CDs); Processing and presentation of antigens. Immunoglobulins: Structure & Types of immunoglobulins, genetic diversity of immunoglobulins, catalytic antibodies. B-cell biology & T-cell biology (Major Histocompatibility Complex (MHC) molecules) HLA and H-2 Systems.

**Unit III:**

Vaccines and Immunization: Types of Vaccines (DNA, Recombinant DNA, Synthetic Peptide and Multivalent vaccine) and their characteristics, Immunization of test animals, Hyperimmunization, Prophylactic immunization. Immune disorders, Hypersensitivities, Autoimmune diseases, Transplantation (tissue) Rejection, Immunodeficiencies.

**Unit IV:**

Complement: Classical, alternative and lectin pathway of complement activation, Regulation of complement system, biological consequence of complement activation. Cytokines, Interferons, TNF, interleukins (1-16), Hematopoietins & Chemokines, Regulation of immune response.

**Unit V:**

Clinical Microbiology: Clinical sample collection and serological testing for important pathogens (bacterial, viral and fungal). Antigen-Antibody reactions in vitro; agglutination reactions (Widal, Haemagglutination), Precipitation reactions (Immunodiffusion, Immuno-electrophoretic method), Immunoblotting, ELISA, RIA, fluorescence immuno sorbent assay, immuno-electronmicroscopy. Hybridoma technology, applications of monoclonal antibodies.

**REFERENCE BOOKS**

1. Riott I M 1998. Essentials of Immunology. Blackwell Scientific Publishers, London.
2. Kindt, Goldsby and d Osborne 2007. Kuby Immunology. Freeman and Co. New York.
3. Claus D 1996. Immunology- Understanding of Immune System. Wiley - Liss, New York.
4. William P 2002. Fundamentals of Immunology.
5. Abbas 2004. Cellular and Molecular Immunology.
6. Benjamin 2004. Immunology- A short Course.

<b>SEMESTER-III</b>			
<b>DSC9</b>	<b>BIOINFORMATICS AND BIOSTATISTICS</b>		<b>18PCMB33</b>
<b>Hrs/Week:5</b>	<b>Hrs/Sem: 5x15= 75</b>	<b>Hrs/Unit: 15</b>	<b>Credits:4</b>

#### **UNIT I**

Introduction and Classification - Components of computer, Generation of computers, Number system, Flow chart, Basics for operating system (MS-DOS, WINDOWS, Unix and Linux), Introduction to softwares: MS-Office (MS-WORD, Power Point, MS- Excel) and Photoshop. Basic concepts of Bioinformatics – Biological sequences – Human Genome Project.

#### **UNIT II**

Nucleic acid databases – Primary – EMBL, Genbank, DDBJ – Secondary databases. Protein sequence databases – Primary and Secondary – Structural databases.

#### **UNIT III**

Sequence Retrieval systems – Entrez – Sequence alignment tools – BLAST and FastA – multiple sequence alignment, Phylogenetical trees. Genomics and proteomics, *Drug designing*, Applications of Bioinformatics.

#### **UNIT IV**

Biostatistics - Definition - Statistical methods - Basic principles. Variables - measurements, Functions, Limitations and Uses of Statistics. Collection of data primary and Secondary - Types and methods of data collection procedures - merits and demerits. Classification - tabulation and presentation of data - sampling methods.

#### **UNIT V**

Measures of central tendency - Mean, Median, Mode, Geometric mean - Merits & Demerits. Measures of dispersion - Range, Standard deviation, Mean deviation, Quartile deviation - Merits and Demerits; Co-efficient of variations. Correlation - Types and methods of Correlation, Regression, Simple Regression equation, Statistical inference - Hypothesis - Simple hypothesis - Student 't' test - Chi square test.

#### **REFERENCE BOOKS:**

1. Introduction to bioinformatics, 2001. AH wood, T.K. Parry smith DJ, Pearson education Asia.
2. C & Unix programming; A conceptual perspective, 1995. Kulti, Tata Mc Graw Hill. Developing bioinformatics in computer skill, Gibas C, Jambeek P.S, oreilly, 2001. associates inc. Shrott publishers
3. Biostatistic, Dannel, W.W., 1987. New York, John Wiley Sons.
4. An introduction to Biostatistics, 3<sup>rd</sup> edition, Sundarrao, P.S.S and Richards, J. Christian Medical College, Vellore.

<b>SEMESTER-III</b>			
<b>DSE 3A</b>	<b>PHARMACEUTICAL MICROBIOLOGY</b>		<b>18PEMB3A</b>
<b>Hrs/Week:4</b>	<b>Hrs/Sem: 4x15=60</b>	<b>Hrs/Unit: 12</b>	<b>Credits:4</b>

#### **UNIT I**

History of Pharmaceutical Microbiology-Microbiological Assay of Pharmaceutical products: Introduction- Importance and Usefulness- Principle- Methodologies- Cylinder-plate method- Turbidimetric Assay method

#### **UNIT II**

Microbiological Assay- Types of Microbiological Assay- Analytical Methods for Microbial Assays- HPLC- RPC-IPC- Pharmaceutical Microbial assay for Antibiotic

#### **UNIT III**

Sterility Testing of Pharmaceutical Products- Introduction- Tests- Membrane filtration- Direct Inoculation (Nutrient broth, cooked meat medium, Sabouraud medium)- Pyrogen testing- Antiseptics- Disinfectants- their Standardization.

#### **UNIT IV**

Production of Vaccine - BCG and Typhoid- Production of Toxoid- Tetanus and Diphtheria. Production of Insulin, interferon- Preparation of Antisera and their standardization.

#### **UNIT V**

Mechanism of action of Antibiotics - Inhibition of cell wall synthesis - Nucleic acid and Protein synthesis.- Bacterial resistant to antibiotics- Mode of action of non-antibiotic antimicrobial agents- Mode of action of bacterial killing by quinolones.

#### **REFERENCE BOOKS:**

1. Hugo W. B and Russell A.D. 1998. Pharamcetical Microbiology. Sixth Edition, The Black well Science Ltd., UK
2. Reed. G. 1982. Prescott and Dunn's Industrial Microbiology. Macmillian Publications

<b>SEMESTER-III</b>			
<b>DSE 3B</b>	<b>BIOTECHNOLOGY</b>		<b>18PEMB3B</b>
<b>Hrs/Week:4</b>	<b>Hrs/Sem: 4x15=60</b>	<b>Hrs/Unit: 12</b>	<b>Credits:4</b>

#### **UNIT I**

Biotechnology – Definition - History, Scope and Importance of Biotechnology, Basic concept of Genetic Engineering

#### **UNIT II**

Nucleic acid – Nucleotides - Structure of Nucleotides - DNA Composition and structure - DNA double helix – other types of DNA structure - Size of the DNA molecule - units of length - Denaturation of the DNA strands. RNA- Structure of RNA – Types of RNA - Messenger RNA - Transfer RNA - Ribosomal RNA - other types of RNA.

#### **UNIT III**

Plant Tissue culture – General - culture media - protoplast culture- somatic hybridization-production of Haploid plants- clonal propagation - Micropropagation, Genetic Engineering of plants- Methodology- Applications of transgenic plant.

#### **UNIT IV**

Animal cell culture- Fundamentals- Application- culture media- cultured cell- biology and characterization- Primary culture and cell line- Animal cell culture-General consideration and scale up- cell viability and cytotoxicity- Cell transformation and cell cloning-organ and Histotypic cultures and Tissue Engineering- Transgenic animals.

#### **UNIT V**

Environmental Biotechnology- Biotechnological Methods for measurement of pollution-criteria- Bioassay- cell biology- Biosensors in environmental monitoring – Biotechnological methods for management of pollution- Bioremediation – Types of bioremediation- metabolic effect of microorganisms on xenobiotics- Types of reaction in Bioremediation- Genetic engineering for more efficient bioremediation- Genetically Engineered Microorganism in bioremediation.

#### **REFERENCE BOOKS**

1. Dubey, R. C. A - Text Book of Biotechnology (4<sup>th</sup> Edition) S.Chand& Company Limited, New Delhi.
2. Gupta, P.K. Elements of Biotechnology. Rastogi Publications, Meerut.
3. Jogdand, S. N .Gene Biotechnology ( 5<sup>th</sup> Edition ) Himalaya Publishing House.



<b>SEMESTER-III</b>			
<b>P-V</b>	<b>CORE MICROBIOLOGY PRACTICALS-V</b>		<b>18PCMB3P1</b>
<b>Hrs/Week:4</b>	<b>Hrs/Sem: 4x15= 60</b>	<b>Hrs/Unit: 12</b>	<b>Credits:2</b>

#### **TECHNIQUES IN MEDICAL MICROBIOLOGY**

1. Isolation of Normal micro flora of skin.
2. Isolation of Normal micro flora of throat.
3. Isolation and identification of UTI causing Pathogen from urine.
4. Isolation and identification of Pathogen from wound.
5. Isolation and identification of pathogen from throat swab.
6. Isolation and identification of Pathogen from sputum.
7. Isolation and identification of Enteric bacteria from stool.
8. Isolation and identification of pathogen from pus.
9. Isolation and identification of bacterial Pathogen from dandruff.
10. Isolation and identification of Fungal pathogen from dandruff.
11. Antibiotic sensitivity test- Well diffusion method.
12. Antibiotic sensitivity test – Disc Diffusion Method.
13. Determination of Minimal inhibitory concentration.

#### **REFERENCE BOOKS:**

1. Cappucino J.G, and Sherman .N, 1996 Microbiology –A laboratory Manual
2. Kannan 1996. Laboratory Manual in General Microbiology Palani Paramount Publications , .Palani

<b>SEMESTER-III</b>		
<b>P-VI</b>	<b>CORE MICROBIOLOGY PRACTICALS-VI</b>	<b>18PCMB3P2</b>
<b>Hrs/Week:4</b>	<b>Hrs/Sem: 4x15= 60</b>	<b>Credits:2</b>

**TECHNIQUES IN IMMUNOLOGY,  
BIOINFORMATICS AND BIostatISTICS**

1. Blood Grouping.
2. WIDAL test- Qualitative and Quantitative.
3. ASO.
4. CRP.
5. VDRL.
6. Antigen- Antibody reaction – Ouchterlony technique.
7. Antigen- Antibody reaction – Single radial Immunodiffusion.
8. ELISA- (DEMO).
9. Western Blot- (DEMO).
10. Northern Blot (DEMO).
11. Southern Blot (DEMO).
12. BLAST exercise.
13. Usage of NCBI resources.
14. Calculation of Mean, Mode, Median.
15. Calculation of Standard Deviation and Standard Error.
16. Analysis of Variance (ANOVA).

**REFERENCE BOOKS:**

1. Cappucino J.G, and Sherman .N, 1996 Microbiology –A laboratory Manual
2. Kannan 1996. Laboratory Manual in General Microbiology Palani Paramount Publications , .Palani

<b>SEMESTER-IV</b>			
<b>DSC 10</b>	<b>FOOD MICROBIOLOGY</b>		<b>18PCMB41</b>
<b>Hrs/Week:5</b>	<b>Hrs/Sem: 5x15= 75</b>	<b>Hrs/Unit: 15</b>	<b>Credits:4</b>

#### **UNIT I**

Factors affecting the growth and survival of microorganisms in foods- Intrinsic factors- Nutrient content, pH,  $E_h$ , Antimicrobials and  $a_w$ , Extrinsic factors- Relative humidity, Temperature and Gaseous atmosphere.

#### **UNIT II**

Methods for studying microbes and their products in food stuffs, Spoilage of fruits and Vegetables, Fresh and Processed Meats and Poultry and Miscellaneous foods such as eggs, bakery products, dairy products, beers and wines, fermented solid-substrate foods, and canned foods.

#### **UNIT III**

Microbiology and food preservation with chemicals, irradiation, low and high temperatures, high pressure, modified atmosphere, low humidity and drying. Manufacture of fermented foods- Dairy products (acidophilus milk, cheese and yogurt), meat and fishery products (dry sausages and fish sauces), plant products (cocoa beans, coffee beans, olives, pickles, sauerkraut, soy sauce, tempe and idli), breads, beverages (cider, sake, vinegar and palm wines).

#### **UNIT IV**

Food-borne diseases and food poisoning by microbial agents- *Aeromonas*; *Brucella*; *Bacillus cereus*; *Campylobacter*; *Clostridium perfringens*; *Escherichia coli*; *Listeria monocytogenes*; *Salmonella*; *Shigella*; *Staphylococcus aureus*; *Vibrio*; *Yersinia enterocolitica*; helminths and nematodes, Protozoa (*Giardia*, *Entamoeba*), Toxigenic algae (Dianoflagellates, Cyanobacteria and Diatoms), Toxigenic fungi (*Aspergillus*, *Penicillium*, and *Fusarium*), and Foodborne viruses (Polio, Hepatitis A and E and Gastroenteritis viruses).

#### **UNIT V**

Food microbiology and public health- Incidence and risk factors of foodborne illnesses. The hazard analysis and critical control point (HACCP), concept in controlling microbiological quality of foods, Predictive models.

#### **REFERENCE BOOKS:**

1. Food Microbiology: Fundamentals and Frontiers, 3e - by M.P. Doyle and L.R. Beuchat
2. Food Microbiology, 2e - by M.R. Adams and M.O. Moss (Royal Society of Chemistry)

<b>SEMESTER-IV</b>			
<b>DSC 11</b>	<b>INDUSTRIAL MICROBIOLOGY</b>		<b>18PCMB42</b>
<b>Hrs/Week:5</b>	<b>Hrs/Sem: 5x15= 75</b>	<b>Hrs/Unit: 15</b>	<b>Credits:4</b>

#### **UNIT-I**

Historical account of microbes in industrial microbiology, Sources and Characters of industrially potent microbes; their Isolation, Purification, Screening of useful strains; Primary Screening & Secondary Screening, Strain improvement through random mutation (random & rational selection), Genetic recombination & Genetic engineering; Microbial growth kinetics in Batch, Continuous & Fed-batch fermentation process.

#### **UNIT-II**

Bioreactor- Principles& Designing, Types of bioreactors, Types of fermentation process, Primary & Secondary metabolites. Microbial production of commercially important products Vitamins, Antibiotics, Hormones, Cyanocobalamine, Riboflavin, Giberllins, Auxins, Microbial Rennets, Penicillin, Semisynthetic Penicillin, Cephalosporin, Streptomycin, and Steroid bioconversions.

#### **UNIT-III**

Microbial production of commercially important solvents and Acids - Alcohol, Acetone, Butanol. Lactic acid, Acetic Acid, Citric acid, Ascorbic acid. Microbial Production of Enzymes – Protease, Amylase, Cellulase and Lipase. Methods of immobilization and applications.

#### **UNIT-IV**

Concept and production of Microbial insecticides (BT, *Trichoderma viridae*), Mass production of Biofertilizers (*Rhizobium* and *Phosphobacterium*), Biopolymers, Bioplastics Biosensors, Single cell protein (Yeast and Spirulina) and Algae as Biofuel.

#### **UNIT-V**

Effluent treatment system in Fermentation Technology – Physical, Chemical and Solid waste Management – Fluid bed Reactors and Trickling Filters. Metagenomics- Scope and applications.

#### **REFERENCE BOOKS:**

1. Principles of Fermentation Technology. Stanbury PFA Whitaker and Hall
2. Textbook of Industrial Microbiology, A. H. Patel.
3. Industrial Microbiology, L. E. Cassida
4. Industrial Microbiology. Presscott and Dunn.
5. Kruger and Kuruger – Industrial Microbiolgy.

<b>SEMESTER-IV</b>		
<b>DSC 12</b>	<b>PROJECT</b>	<b>18PCMB43</b>
<b>Hrs/Week:8</b>	<b>Hrs/Sem: 8x15= 120</b>	<b>Credits:8</b>

### **RESEARCH PROJECT**

To plan and design statistically, retrieve relevant literature, organize and process the data, photograph relevant observations, evaluate by statistical programme, present the project in any State/ Regional / National conference/ Seminar during the second year of the course and submit during the final semester examinations. The work has to be conducted in the Department / Collaborative organization / Institute under the guidance of the Project Supervisor. Inter-disciplinary collaborations from External Departments / Institutions can also be organized for essential areas of the Project if necessary. The method of valuation of the project report submitted by the candidate is outlined under the course project and *viva-voce*.

The project report should be submitted to the Head of the Course Department “One week prior” to the commencement of the practical examination in the Fourth Semester. Each student has to submit 3 copies of his / her project report for evaluation.

### **INDUSTRIAL VISIT**

An educational tour to leading industrial institutes should be conducted as an eye opener and to basically understand the advanced technological know how which is a must. This exposure and orientation to Advanced Instruments / Gadgetries / On-line Process / By-product Recoveries / Involved Strategies and Implications would alleviate the level of scientific knowledge by all standards. A report pertaining to the visit of scientific learning shall be submitted for evaluation. On-Duty leave should be granted to the teachers accompanying the students. The industrial visit shall include Food, Dairy, Pharmaceutical, Biotechnological, Agricultural, Beverage and Fermentation, Enzyme Production, Solid and Liquid Waste Management, processing plants and research based organizations (Fundamental and Advanced Centers of Eminence)

### **PRESENTATION OF SCIENTIFIC FINDINGS**

Each student will have to present their scientific findings of individual work (or) collaborative work in any State / Regional / National International Seminar or Symposia. Alternatively, they can attend any workshops conducted by the State / National Organizations of Scientific Recognition. Abstracts / Papers presented along with certificates will have to be produced during examination. Scientific papers published in Journals / Proceedings during his / her Master Programme will be given special weightage.

### **GENERAL VIVA - VOCE**

The examiners shall conduct a General *Viva-Voce* pertaining to the core course papers as an overall component.

### **Objective:**

Every PG student is required to prepare the project subject related – based on the guidelines of his project guide.

### **The following are the guidelines to be adhered to**

- The project should be an individual one

- The language for the project is **English**
- The Minimum number of pages should be **60**
- Project observations, suggestions and conclusion shall be formed as part of the project.
- The Projects will be evaluated both by the Internal as well as External Examiner each for 100 marks. The distribution of mark should be **60 marks for the Project Report and 40 marks for the Viva-voce Examination**. The Division of marks for the Project Report is as mentioned below:

<b>Particulars</b>	<b>Internal Examiner</b>	<b>External Examiner</b>
Wording of Title	5	5
Objectives/ Formulation including Hypothesis	5	5
Review of Literature	10	10
Relevance of Project to Social Needs	5	5
Methodology/ Technique/ Procedure Adopted	20	20
Summary/ Findings/ Conclusion/Future recommendations.	5	5
Bibliography/ Annexure/ Foot notes	10	10
<b>Total</b>	<b>60</b>	<b>60</b>

The average mark of Internal and External Examiner is considered as marks of Dissertation report

<b>SEMESTER-IV</b>			
<b>DSE 4A</b>	<b>VERMI TECHNOLOGY AND MUSHROOM CULTIVATION</b>		<b>18PEMB4A</b>
<b>Hrs/Week:4</b>	<b>Hrs/Sem: 4x15= 60</b>	<b>Hrs/Unit: 12</b>	<b>Credits:4</b>

#### **UNIT-I:**

Earthworm Classification – Morphology and Anatomy. Biology of *Lampitomaruitii*. Vermicomposting - Definition, Introduction and Scope- The nature of earthworms-soil environment-basic environmental requirements.

#### **UNIT-II:**

Vermicomposting materials and their Classification, Physical, chemical and biological changes brought by earthworm in Soil Structure - Carbon, Nitrogen and Phosphorous transformations. Vermicomposting methods - Optimal conditions for Vermiculture - temperature, moisture, pH, soil type, organic matter, Vermicomposting in Homes, Maintenance of vermicomposting beds. Harvesting the worms. Earthworm predators, parasites and pathogens. Vermiwash, Applications of vermicomposting,

#### **UNIT-III:**

Mushroom Technology - Introduction, History and Scope –Morphology of mushroom - Vegetative characters - Formation and development of Basidiocarp, Structure of basidiocarp - *Agaricus*. Edible and Poisonous Mushrooms. Medicinal and nutritive value of edible mushrooms. Food preparation- soup, cutlet, vegetable curry, samosa, omlette and pickle. Mushroom research centers in India.

#### **UNIT-IV:**

Cultivation of button mushroom (*Agaricusbisporus*), milky mushroom (*Calocybeindica*), oyster mushroom (*Pleurotussajorcaju*) and paddy straw mushroom (*Volvariellavolvcea*).Preparation of Pure Culture and spawn cultivation methods.

#### **UNIT-V:**

Cultivation technology - Substrates, Bed, Polythene- Bag preparation, spawning - casing - Cropping - Mushroom production - Harvest - Storage methods and marketing. Post harvest technology: Storage-Freezing, dry Freezing, drying, canning.

#### **REFERENCES:**

1. Edwards, C.A. and Bohlen, P.J. 1996, Ecology of earthworms-3<sup>rd</sup> Edition, Chapman and hall.
2. Jsmail, S.A., 1970, Vermicology. The biology of earthworms. Orient Longman, London.
3. Lee, K.E., 1985. Earthworms - Their ecology and relationship with soil and land use, Academic Press, Sydney.
4. Ranganathan L.S. 2006. Vermibiotechnology from soil health to human health. Agrobios India.
5. Gupta P.K. 2008. Vermicomposting for sustainable agriculture. Agrobios. India.

<b>SEMESTER-IV</b>			
<b>DSE 4B</b>	<b>BIOINSTRUMENTATION AND RESEARCH METHODOLOGY</b>		<b>18PCMB4B</b>
<b>Hrs/Week:4</b>	<b>Hrs/Sem: 4x15= 60</b>	<b>Hrs/Unit: 12</b>	<b>Credits:4</b>

#### **UNIT – I : Microscopy, pH and buffer**

General laboratory procedures and maintenance of research equipments – Microscopy - General Principles - Confocal microscope, SEM and TEM. pH basic Principles and construction of pH meter- pH electrodes- Principles and application of buffers –Mechanism of buffer action and preparation of common buffers –Citrate, acetate, tris and phosphate-Application of buffers- pH measurements of soil and water.

#### **UNIT – II : Isolation, Fractionation and Separation**

Isolation, Fractionation and Separation of cellular constituents – Isolation of Chloroplasts, Mitochondria, Nucleic acids and enzymes – Homogenization –Manual, Mechanical and Sonication – Centrifugation- Centrifuges and their Uses- Micro centrifuge, High speed refrigerated centrifuges, Ultra centrifuges, Differential and density gradient centrifugation – Chromatography –Paper, Thin layer-Separation of amino acids and sugars-Gas liquid chromatography, HPLC and PCR –Principle and Applications.

#### **UNIT – III :**

Electrophoresis – Principles, factors affecting electrophoretic mobility – Support medium –Agarose and polyacrylamide gels- Electrophoresis of proteins and nucleic acids- Spectroscopic techniques –UV –visible, MALDI-TOF, LC-MS and AAS-principles, Instrumentation and applications-Estimation of cellular constituents- Sugars, amino acids and proteins –Flame photometer and Bomb calorimeter- Principle and applications.

#### **UNIT – IV : Research and Project writing methods**

Research-Definition, Objectives, Types and Importance - Research methods in biological sciences - Research process- Literature survey – Sources –Scientific databases- Research report writing – Parts of Thesis and Dissertation –Title, certificate, declaration, acknowledgements, contents, List of tables, figures, plates & abbreviations, Introduction, Review of literature, Materials and methods-Results – Presentation of data – Tables, figures, map, graphs, photographs – Discussion – Summary, Bibliography/ References and Appendix.

#### **UNIT – V : Article Publication**

Presentation in Seminars and Conferences – Writing scientific paper – Organization of scientific paper – Importance of title – abstract –key words, Introduction, Materials and methods, Results, Discussion. Acknowledgements and References – Publication in research journals – Standards of Research journals- Peer – Review – Impact factor – Citation index – Preparation of manuscript – Proof correction – Proof correction marks- Method of correcting proof- Writing chapters in books – Preparation of Research proposal and funding agencies – Research fellowships.

#### **REFERENCE BOOKS:**

1. Vijayalakshmi.G. and C.Sivapragasam (2008). Research Methods (Tips and Techniques). MJP Publishers, Chennai.
2. Gurumani.N. (2006). Research Methodology for Biological Sciences. MJP Publishers, Chennai.
3. Ramamurthi and Geetha Bali (2007). Bioethics and Biosafety.APH Publishing, New Delhi.



<b>SEMESTER-IV</b>		
<b>P -VII</b>	<b>CORE MICROBIOLOGY PRACTICALS-VII</b>	<b>18PCMB4P1</b>
<b>Hrs/Week:4</b>	<b>Hrs/Sem: 4x15= 60</b>	<b>Credits:2</b>

**TECHNIQUES IN FOOD AND INDUSTRIAL  
MICROBIOLOGY**

1. Isolation and identification of yeast from Idly batter.
2. Isolation of yeast from grape juice.
3. Isolation and identification of Bacteria from spoiled fruit.
4. Isolation and identification of Bacteria from spoiled Vegetable.
5. Isolation and identification of Bacteria from spoiled meat.
6. Isolation and identification of Bacteria from spoiled fish..
7. Wet mount Preparation spoiled bread, grapes
8. Isolation and identification of industrially important micro organisms-crowded plate technique-giant colony technique.
9. Ethanol Fermentation.
10. Immobilization of an enzyme or Cell.
11. Production of Streptomycin (DEMO).
12. Production of Beer (DEMO).
13. Production of Wine (DEMO).

**REFERENCE BOOKS:**

1. Cappucino J.G, and Sherman .N, 1996 Microbiology –A laboratory Manual
2. Kannan 1996. Laboratory Manual in General Microbiology Palani Paramount Publications, Palani.

<b>SEMESTER-IV</b>		
<b>P - VIII</b>	<b>CORE MICROBIOLOGY PRACTICALS-VIII</b>	<b>18PCMB4P2</b>
<b>Hrs/Week:4</b>	<b>Hrs/Sem: 4x15= 60</b>	<b>Credits:2</b>

#### **TECHNIQUES IN APPLIED MICROBIOLOGY**

1. Isolation and identification of free living nitrogen fixing Bacteria (*Azotobacter*) from soil.
2. Isolation and identification of Symbiotic Nitrogen fixing bacteria (*Rhizobium*) from Root Nodule.
3. Enumeration of microorganism from phyllosphere.
4. Determination of Solubility of drug at room temperature.
5. Sterility testing of Pharmaceuticals.
6. Microbiological assay of antibiotics by cup plate method.
7. Bioassay of chlormphenicol by plate assay method and turbidimetric Assay method.
8. Plant Tissue culture – Micropropagation (Demonstration).
9. Animal cell Culture – Monolayer Culture (Demonstration).
10. Cultivation of Mushroom – Polythene bag Method.
11. Production of Vermicompost.
12. Production of Vermiwash.

#### **Reference Books:**

1. Gunasekaran. P. (1996). Laboratory Manual in Microbiology. New Age International Ltd., Publishers, New Delhi.
2. Dubey, R.C.andMaheswari,D.K. (2002).Practical Microbiology, 1<sup>st</sup> Edition Chand and Company Ltd., India.
3. Aneja K.R.(1993). Experiments in Microbiology, Plant Pathology and Tissue Culture. WishwaPrakashan.NewDelhi, India.
4. Benson. (2002). Microbiological Applications – Laboratory Manual in General Microbiology. International Edition, McGraw Hill Higher Education.
5. Jayaraman, J. (1985). Laboratory Manual in Biochemistry. Wiley Eastern Ltd., New Delhi.
6. Plummer. D.T. (1998). An Introduction to Practical Biochemistry. Tata McGraw Hill, New Delhi.

**IDC SUBJECTS OFFERED BY DEPARTMENT OF MICROBIOLOGY TO OTHER MAJOR STUDENTS**

<b>SEMESTER-II</b>			
<b>IDC-I</b>	<b>Microbiology and Human Health</b>		<b>18PIMB21</b>
<b>Hrs/Week:3</b>	<b>Hrs/Sem: 3x15= 45</b>	<b>Hrs/Unit: 9</b>	<b>Credits:3</b>

**Unit I**

Normal flora of human body, Role of the resident flora, Brief account of major air, and water borne diseases of microbial origin and their preventive and control measures.

**Unit II:**

Bacteriology- Important human diseases caused by *Staphylococcus*, *Streptococcus*, *Neisseria*, *Bacillus*, *Corynebacterium*, *Clostridium*, *Pseudomonas*, *Yersinia*, *Haemophilus*, *Mycobacterium*, Antibacterial agents and susceptibility test, Bacterial vaccines.

**Unit III:**

Virology-Important human viral diseases - Mumps, Measles, Influenza, Enterovirus, Rhinovirus, Poxvirus, Hepatitis virus; Herpesvirus, AIDS, Antiviral drugs, Viral vaccines

**Unit IV:**

Mycology- Important human fungal diseases: Candidiasis, Dermatophytosis, Aspergillosis, Cutaneous and subcutaneous mycoses, Systemic mycoses, Opportunistic mycoses, Antifungal agents.

**Unit V:**

Parasitology- Important human Protozoal diseases: *Entamoeba*, *Giardia*, *Trichomonas*. Blood and tissue protozoa; *Plasmodium*, *Trypanosoma*, *Leishmania*, *Taenia*, *Schistosoma*, Nematodes: *Ascaris*, Filariasis, treatment and prevention, Antiparasitic agents.

**REFERENCE BOOKS**

1. Greenwood D. 2007. Medical Microbiology 4<sup>th</sup> Ed., I.K. International.
2. Murray P.R., Tenover F.C., & Tenover F.C., & Tenover F.C. 2007. Clinical Microbiology, ASM Press.
3. Talaro K. P. & Talaro A. 2006. Foundations in Microbiology (6<sup>th</sup> Ed.), McGraw-Hill College Dimensi.
4. Willey J., Sherwood L. and Woolverton C. 2007. Prescott/Harley/Klein's Microbiology, McGraw Hill.
5. Atlas R. M. 1997. Principles of Microbiology 2<sup>nd</sup> Ed., McGraw Hill.
6. Nester E. W., Anderson D. G. & Nester M. T. 2006. Microbiology: A Human Perspective, McGrawHill.
7. Harvey, R.A., Champe, P.C. and Fisher, B.D. 2007. Lippincott's Illustrated Reviews : Microbiology.

<b>SEMESTER-III</b>			
<b>IDC-II</b>	<b>ENTREPRENEURSHIP IN MICROBIOLOGY</b>		<b>18PIMB31</b>
<b>Hrs/Week:3</b>	<b>Hrs/Sem: 3x15= 45</b>	<b>Hrs/Unit: 9</b>	<b>Credits:3</b>

#### **UNIT-I**

Entrepreneur- Definition, Characteristics, Function, Types, Entrepreneurship: Definitions - concept, Factors affecting Entrepreneurial growth, Entrepreneurial motivation, Entrepreneurial competencies– Role of Entrepreneurship in Economic Development.

#### **UNIT-II**

Production of microbiological products. Fermented dairy products, Food-SCP (Algae, Spirulina, Yeast, Mushroom, Bacterial probiotics). Commercial SCP Products in the market

#### **UNIT-III**

Biofertilizer – (*Cyanobacteria*, *Rhizobium*, *Azospirillum*, *Azotobacter*, *Frankia*, VAM). Vermicompost, Bioinsecticide (*Bacillus thuriangiensis*).

#### **UNIT-IV**

Marine resources-Sea weed, Sea grass, Coral reefs- Types, cultivation and harvesting methods and products.

#### **UNIT-V**

Finance and Support to Bio entrepreneurs - Government initiatives and Schemes. DST, CSIR, ICMR, DBT-BIRAC, BIG scheme, SIPCOT. Nationalized banks and other financial institutions.

#### **Text Books**

1. Khanka SS (2006). **Entrepreneurial Development**. S Chand Publishing, New Delhi.
2. Naidu NVR and Krishnarao T (2008). **Management and Entrepreneurship**. I.K. International Pvt. Ltd, New Delhi.
3. Venkataraman GS (1972). **Algal Biofertilizers and Rice Cultivation**. Today and Tomorrow's Printers and Publishers, New Delhi.
4. Gordon E and Natarajan K. **Entrepreneurship Development**. 5<sup>th</sup> Edition. Himalaya Publishing House, New Delhi.

#### **Reference Books**

1. Hisrich RD, Peters MP and Shepherd DA (2005). **Entrepreneurship**. 6<sup>th</sup> Edition, Mc Graw Hill Irwin.
2. Bhatnagar B and Budhiraja A (2011). **Entrepreneurship Development and Small Business Management**. Vayu Education of India, New Delhi.
3. Gupta CB and Srinivasan NP (2014). **Entrepreneurial Development in India**. Sultan Chand & Sons, New Delhi.
4. Tilak, KVBR (1990). **Bacterial Biofertilizers**. IARI Publications, New Delhi.