

AC-10-2-2012

Item No. 4.24

# UNIVERSITY OF MUMBAI



**Syllabus for the M.Sc. Part - I**

**Program: M.Sc.**

**Course : Microbiology(PSMB)**

(Credit Based Semester and Grading System with  
effect from the academic year 2012–2013)

**M.Sc. Microbiology Syllabus(Semester – I & Semester - II)**

**Revised for Credit Based and Grading System**

**To be implemented from the Academic year 2012-2013**

**SEMESTER I**

**Theory:**

<b>Course Code</b>	<b>UNIT</b>	<b>TOPIC HEADINGS</b>	<b>Credits</b>	<b>L / Week</b>
<b>PSMB-101 Cell Biology &amp; Virology</b>	<b>I</b>	<b>Virology(Bacterial Viruses)</b>	<b>4</b>	<b>01</b>
	<b>II</b>	<b>Virology(Plant Viruses)</b>		<b>01</b>
	<b>III</b>	<b>Cell Biology(Membrane Structure &amp; Transport)</b>		<b>01</b>
	<b>IV</b>	<b>Cell Biology(Respiratory &amp; Photosynthetic Organelle)</b>		<b>01</b>

<b>PSMB-102 Microbial Genetics</b>	<b>I</b>	<b>Gene expression and regulation</b>	<b>4</b>	<b>01</b>
	<b>II</b>	<b>Replication, recombination, mutation and repair</b>		<b>01</b>
	<b>III</b>	<b>Cytoplasmic Inheritance &amp; Chromosomal Rearrangements</b>		<b>01</b>
	<b>IV</b>	<b>Molecular tools for genetics, Population genetics</b>		<b>01</b>

<b>PS MB-103</b>	<b>I</b>	<b>Aqueous Solutions and Acid –</b>	<b>4</b>	<b>01</b>
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<b>Microbial Biochemistry</b>		<b>Base Chemistry.</b>		
	<b>II</b>	<b>Bioorganic Molecules</b>		<b>01</b>
	<b>III</b>	<b>Metabolism of one &amp; two carbon compounds.</b>		<b>01</b>
	<b>IV</b>	<b>Transfer of biomolecules.</b>		<b>01</b>

<b>PS MB-104 Medical Microbiology &amp; Immunology</b>	<b>I</b>	<b>Advances in Medical Microbiology:Part I</b>	<b>4</b>	<b>01</b>
	<b>II</b>	<b>Epidemiology of infectious diseases</b>		<b>01</b>
	<b>III</b>	<b>Immune System and Health : Part I</b>		<b>01</b>
	<b>IV</b>	<b>Recent advances in Immunology :Immunobiology.</b>		<b>01</b>

**Practicals:**

<b>PSMBP-101</b>	<b>Cell Biology and Virology</b>	<b>2</b>	<b>04</b>
<b>PSMBP-102</b>	<b>Microbial Genetics</b>	<b>2</b>	<b>04</b>
<b>PSMBP-103</b>	<b>Microbial Biochemistry</b>	<b>2</b>	<b>04</b>
<b>PSMBP-104</b>	<b>Medical Microbiology &amp; Immunology</b>	<b>2</b>	<b>04</b>

## SEMESTER II

Theory:

Course Code	UNIT	TOPIC HEADINGS	Credits	L / Week
<b>PSMB-201</b> <b>Cell Biology &amp; Virology</b>	I	<b>Virology(Animal Viruses)</b>	<b>4</b>	<b>01</b>
	II	<b>Virology in relation to human health</b>		<b>01</b>
	III	<b>Cell Biology (Cell division and Cell cycle)</b>		<b>01</b>
	IV	<b>Cell Biology (Cell Communication)</b>		<b>01</b>

<b>PSMB-202</b> <b>Microbial Genetics</b>	I	<b>Viral Genetics, Gene transfer</b>	<b>4</b>	<b>01</b>
	II	<b>Transposable Genetic Elements, Genetic basis of Cancer.</b>		<b>01</b>
	III	<b>Developmental Genetics</b>		<b>01</b>
	IV	<b>Applications and Ethics of Genetic Technology</b>		<b>01</b>

<b>PSMB-203</b> <b>Microbial Biochemistry</b>	I	<b>Analytical Biochemistry</b>	<b>4</b>	<b>01</b>
	II	<b>Enzymology</b>		<b>01</b>
	III	<b>Signalling and stress</b>		<b>01</b>
	IV	<b>Microbial degradation</b>		<b>01</b>

<b>PSMB-204</b> <b>Medical</b> <b>Microbiology</b> <b>&amp;</b> <b>Immunology</b>	<b>I</b>	<b>Advances in Medical Microbiology: Part II</b>	<b>4</b>	<b>01</b>
	<b>II</b>	<b>Clinical Research and Modern diagnostics</b>		<b>01</b>
	<b>III</b>	<b>Immune system and Health : Part II</b>		<b>01</b>
	<b>IV</b>	<b>Challenges in Immune System</b>		<b>01</b>

**Practicals :**

<b>PSMBP-201</b>	<b>Cell Biology and Virology</b>	<b>2</b>	<b>04</b>
<b>PSMBP-202</b>	<b>Microbial Genetics</b>	<b>2</b>	<b>04</b>
<b>PSMBP-203</b>	<b>Microbial Biochemistry</b>	<b>2</b>	<b>04</b>
<b>PSMBP-204</b>	<b>Medical Microbiology &amp; Immunology</b>	<b>2</b>	<b>04</b>

**M.Sc. (Semester – I & Semester - II) Microbiology Syllabus**  
**Revised According To Credit Based and Grading System**  
**To be implemented from the Academic year 2012-2013**

**Semester I Detail Syllabus**  
**PSMB-101 (Cell Biology & Virology )**

Course Code	Title	Credits
PSMB-101	Cell Biology & Virology (60L)	04
<p style="text-align: center;"><b>Unit I: (15L)</b></p> <p style="text-align: center;"><b>VIROLOGY(Bacterial Viruses)</b></p> <p><b>1.1 Bacteriophages : General properties of phages, properties of phage infected Bacterial cultures, Specificity of Phage Infection (3L)</b></p> <p><b>1.2 <i>E. coli</i> Phage T4 : Properties of T4 DNA, Genetic organization, the T4 growth cycle, Replication of T4 DNA (3L)</b></p> <p><b>1.3 <i>E. coli</i> Phage T7 and Lambda : Organization of the T7 genes, Growth Cycle, Regulation of transcription of T7 phage. (4L)</b></p> <p><b>1.4 <i>E. coli</i> Phage (phi) X174, Filamentous DNA phages, Single stranded RNA phages, Lysogenic cycle. (5L)</b></p>		01
<p style="text-align: center;"><b>Unit II: (15L)</b></p> <p style="text-align: center;"><b>VIROLOGY(Plant Viruses)</b></p> <p><b>2.1 Plant viruses : Morphology, Transmission of plant viruses, symptoms of plant diseases caused by viruses. (4L)</b></p> <p><b>2.2 Plant virus life cycles, Plant satellite viruses and satellite Nucleic acids</b></p>		01

<p>(3L)</p> <p><b>2.3 TMV, Citrus Tristeza Virus (CTV), : Viral structure, Genome, Host range, Transmission, Symptom and Control. (6L)</b></p> <p><b>2.4 Diagnosis of viral infections in plants (2L)</b></p>	
<p><b>Unit : III (15L)</b></p> <p><b>CELL BIOLOGY(Membrane structure and transport)</b></p> <p><b>3.1 Cell membrane structure : Lipid bilayer, membrane proteins, Spectrins, Glycophorin, Multipass membrane proteins Bacteriorhodopsin (4L)</b></p> <p><b>3.2 Membrane Transport : Principles of membrane transport, ion channels and electrical properties of membranes. (3L)</b></p> <p><b>3.3 Intracellular Compartments and protein sorting: Compartmentalization of cells, transport of molecules between the nucleus and cytosol, peroxisomes, Endoplasmic reticulum, transport of proteins into mitochondria and chloroplasts ( 5L)</b></p> <p><b>3.4 Intracellular vesicular traffic : Endocytosis, exocytosis, transport from the ER through the Golgi apparatus (3L)</b></p>	<p><b>01</b></p>
<p><b>Unit : IV (15L)</b></p> <p><b>CELL BIOLOGY(Respiratory &amp; Photosynthetic organelle)</b></p> <p><b>4.1 Mitochondria : Structure, electron-transport chains and proton pump (3L)</b></p> <p><b>4.2 Chloroplasts : Structure, energy capture from sunlight, genetic system (3L)</b></p> <p><b>4.3 Cytoskeleton : Cytoskeletal filaments, Microtubules, Actin regulation, molecular motors, cell behavior. (5L)</b></p> <p><b>4.4 Cell study : Study of cells under the microscope, Phase contrast, Fluorescence microscopy , Confocal microscopy &amp; electron microscopy.(4 L)</b></p>	<p><b>01</b></p>

## **SEMESTER I**

### **PRACTICALS : PSMBP- 101 (60 Contact Hrs)**

- 1) Isolation and Purification of coliphages from sewage**
- 2) Phage Typing of E. coli and Salmonella strains.**
- 3) Study of One Step Growth Curve of Lambda phage / T4 Phage.**
- 4) Study of Lysogeny in E. coli.**
  - 5) Assignment on Virology – Research Paper.**
  - 6) Isolation of Lysozyme from egg white.**
- 7)Preparation of protoplast using Lysozyme.**
- 8)Writing a Research proposal.**
- 9)Study of cell cytology using Phase contrast Microscopy. Demonstration**
- 10)Study of Cell structure using Confocal Microscopy. Demonstration**
- 11)Study of Cell structure using Fluorescence Microscopy. Demonstration**
- 12)Isolation of Chloroplasts.**
- 13)Isolation of Mitochondria from the cell.**

### **REFERENCES :**

- 1) General Virology – Luria**
- 2) Introduction to Plant Virology – BOS, I. Longman, London, NY.**
- 3) Animal Virology – Fenner and White. Academic Press. NY**
- 4) Chemistry of Viruses – Knight C. Springer Verlag. NY**
- 5) Virology – Delbecco and Giasberg. Harper and Ravi Pub. NY.**
- 6) Bacterial and Bacteriophage Genetics – Edward Birge**
- 7) Microbial and Plant Protoplasts – Perberely**
- 8) Principles of Virology – Flint, Enquist, Racaniello & Skalka, Vol I and II. ASM,**
- 9) Understanding Viruses – Teri Shors. Jones and Bartlett pub.**
- 10) Molecular Biology of The Cell – Albert, Johnson, Lewis, Raff, Roberts &Walter.**
- 11) Molecular Cell Biology. Lodish , Birk, and Zipursky. Freeman**
- 12) The Structure and Dynamics of Cell Membrane. – Lipowsky and Sackmann. Elsevier.,**



13) Cell Movements : from Molecules to Motility- Bray Garland Pub. NY.

Course code: PSMB-102

(Microbial Genetics)

Semester I

Course Code	Title	Credits
PSMB-102	Microbial Genetics (60L)	04
Unit I:	1.1 Gene Expression [05L] (15L)	
	<p><b>A. Transcription-</b></p> <p>i. Transcription process in prokaryotes</p> <p>ii. Transcription process in eukaryotes</p> <p><b>B. RNA molecules and processing-</b></p> <p>i. Post transcriptional processing- structure of mRNA, pre-mRNA processing, addition of 5'cap, addition of Poly(A) tail, RNA splicing, RNA editing.</p> <p>ii. Small RNA molecules- RNA interference, types, processing &amp; function of microRNAs.</p> <p><b>C. Translation-</b></p> <p>i. Mechanism of translation- charging of tRNA molecules, initiation, elongation and termination, mRNA surveillance.</p> <p>ii. Post translational modification of proteins</p>	01
	1.2 Regulation of gene expression- [10L]	
	<p><b>A. Control of gene expression in prokaryotes-</b></p> <p>i. Genes &amp; regulatory element</p> <p>ii. Levels of gene regulation</p> <p>iii. DNA binding proteins</p> <p>iv. Antisense RNA molecules</p> <p>v. Riboswitches</p> <p><b>B. Control of gene expression in eukaryotes-</b></p> <p>i. Regulation through modification of gene structure- DNase</p>	

<p><b>I hypersensitivity, histone modifications, chromatin remodeling, DNA methylation.</b></p> <p><b>ii. Regulation through transcriptional activators, Co-activators &amp; repressors, enhancers and insulators</b></p> <p><b>iii. Regulation through RNA processing &amp; degradation</b></p> <p><b>iv. Regulation through RNA interference.</b></p>	
<p><b>Unit II: Replication, recombination, mutation and repair (15L)</b></p> <p><b>2.1 Regulation of replication [3L]</b></p> <p><b>A. Bacterial replication and cell cycle</b></p> <p><b>2.2 Recombination [6L]</b></p> <p><b>A. Models for homologous recombination</b></p> <p><b>B. Homologous recombination protein machines</b></p> <p><b>C. Homologous recombination in eukaryotes</b></p> <p><b>D. Mating type switching</b></p> <p><b>E. Genetic consequences of the mechanism of Homologous recombination</b></p> <p><b>2.3 Mutation [3L]</b></p> <p><b>A. Mutation: Basic features of the process</b></p> <p><b>B. Mutations:</b></p> <p><b>i. Phenotypic effects</b></p> <p><b>ii. Mutations in humans and their effects</b></p> <p><b>iii. Conditional lethal mutations</b></p> <p><b>C. Molecular basis of mutation (Types, mutations induced by chemicals, radiation and transposable genetic elements; expanding trinucleotide repeats and inherited human diseases)</b></p> <p><b>D. Screening chemicals for mutagenicity (Ame's test)</b></p> <p><b>2.4 DNA repair mechanisms [3L]</b></p> <p><b>A. Types of repair mechanisms</b></p>	<p><b>01</b></p>

<ul style="list-style-type: none"> <li><b>i. Direct repair,</b></li> <li><b>ii. Light dependent repair,</b></li> <li><b>iii. Excision repair in E. coli and mammalian cells,</b></li> <li><b>iv. Mismatch repair, controlling the direction of mismatch repair,</b></li> <li><b>v. Base flipping by methylases and glycosylases,</b></li> <li><b>vi. Recombination repair in E. coli, recombination as a mechanism to recover from replication errors,</b></li> <li><b>vii. SOS repair,</b></li> <li><b>viii. Conserved repair systems in eukaryotic cells,</b></li> <li><b>ix. Non-homologous end joining (NHEJ) pathway for repairing double stranded breaks</b></li> </ul> <p><b>B. Inherited human diseases with defects in DNA repair</b></p>	
<p><b>Unit III: Cytoplasmic Inheritance &amp; Chromosomal Rearrangements (15L)</b></p> <p><b>3.1 Cytoplasmic Inheritance (Organellar Genetics) [10L]</b></p> <ul style="list-style-type: none"> <li><b>A. mt-DNA</b> <ul style="list-style-type: none"> <li><b>i. Mitochondrial genome structure</b></li> <li><b>ii. Ancestral and derived mitochondrial genome</b></li> <li><b>iii. Mitochondrial DNA of Human, yeast and flowering plants</b></li> <li><b>iv. Endosymbiotic theory</b></li> <li><b>v. Mitochondrial DNA replication, transcription &amp; translation</b></li> <li><b>vi. Codon usage in Mitochondria</b></li> <li><b>vii. Damage to Mitochondrial DNA and aging.</b></li> </ul> </li> </ul>	<p><b>01</b></p>

- viii. **Evolution of Mitochondrial DNA**
- ix. **mt DNA analysis for study of evolutionary relationships**
- B. **cp DNA**
  - i. **Gene structure and organization**
  - ii. **General features of replication, transcription and translation of cpDNA**
  - iii. **Comparison of nuclear, eukaryotic, eubacterial mitochondrial and chloroplast DNA**
  - iv. **Examples of extra nuclear inheritance-**
  - v. **Leaf Variegation,**
  - vi. **Poky mutant of Neurospora,**
  - vii. **Yeast petite mutant,**
  - viii. **Human genetic diseases**
  - ix. **Maps of mt DNA and cp DNA**

### **3.2 Chromosomal Rearrangements and effects on gene expression [5L]**

- A. **Amplification and deletion of genes**
- B. **Inversions that alter gene expression**
- C. **Transpositions that alter gene**
  - i. **Expression antigenic variation in Trypanosomes**
  - ii. **Mating type switching in yeast**
  - iii. **Phase variation in Salmonella**

<p><b>Unit IV: Molecular tools for genetics, Population genetics (15L)</b></p> <p><b>4.1 Molecular tools for genetics [9L]</b></p> <p><b>A. Molecular tools for studying genes and gene activity</b></p> <p><b>B. Use of recombinant DNA technology to identify human genes (Huntington’s diseases, Cystic fibrosis), molecular diagnosis of human diseases, human gene therapy)</b></p> <p><b>C. Labeled tracers (autoradiography, phosphorimaging, liquid scintillation counting, non-radioactive tracers)</b></p> <p><b>D. Nucleic acid hybridization (Southern blots, DNA fingerprinting &amp; DNA typing with their forensic applications, Northern blots, in situ hybridization), DNA sequencing (Sanger’s chain termination method, Maxam Gilbert’s sequencing), Restriction mapping, Site directed mutagenesis</b></p> <p><b>E. Mapping and quantifying transcripts (S1 mapping, primer extension, run-off transcription)</b></p> <p><b>F. Measuring transcription rates in vivo (Nuclear run – on transcription, reporter gene transcription), Assaying DNA –protein interactions (filter binding, gel mobility shift, DNAase and DMS footprinting, knockouts)</b></p> <p><b>4.2 Population genetics [6L]</b></p> <p><b>A. Population and gene pool</b></p> <p><b>B. Genotypic and Allelic frequencies</b></p> <p><b>C. Calculation of Genotypic frequencies and Allelic frequencies for autosomal and X linked loci</b></p> <p><b>D. Problems –calculation of allelic and genotypic frequencies</b></p> <p><b>E. Hardy-Weinberg Law, genotypic frequencies at HWE,</b></p> <p><b>F. Implications of the H-W Law ,</b></p> <p><b>G. H-W proportions for multiple alleles,</b></p> <p><b>H. X-linked alleles</b></p>	<p><b>01</b></p>

<p><b>I. Testing for H-W proportions and problems</b></p> <p><b>J. Genetic ill effects of in-breeding</b></p> <p><b>K. Changes in the genetic structure of populations:</b></p> <ul style="list-style-type: none"> <li><b>i. Mutation,</b></li> <li><b>ii. Migration and gene flow,</b></li> <li><b>iii. Genetic drift,</b></li> <li><b>iv. Natural selection</b></li> <li><b>v. Simple problems based on the natural forces</b></li> </ul> <p><b>L. Measuring genetic variation :</b></p> <ul style="list-style-type: none"> <li><b>i. RFLP, DNA sequencing</b></li> <li><b>ii. Protein electrophoresis</b></li> </ul>	
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**PRACTICALS : PSMBP- 102 (60 Contact Hrs)**

**List of practicals for Semester I**

- 1.  $\beta$  galactosidase assay**
- 2. UV mutagenesis**
- 3. Acridine orange mutagenesis**
- 4. Isolation of mutants by Replica plate technique**
- 5. Penicillin enrichment technique**
- 6. Ames test**
- 7. Southern hybridization technique [Demonstration]**
- 8. Northern Blotting technique [Demonstration]**
- 9. Restriction mapping**
- 10. Design of primer & PCR**
- 11. Protein electrophoresis**
- 12. Problems on population genetics**

**References:**

**Unit I –**

**Genetics: A Conceptual Approach, 3<sup>rd</sup> Edition by Benjamin Pierce [pg 353-362, 373-380, 386-387, 407- 417, 427-428, 445-447 , - 454-465]**

## Unit II -

- A. Gene X – Lewin [pg. 409-424]
- B. Molecular biology of the gene Vth edi. Watson [pg 259-292]
- C. & D.
- i. Snustad [pg ]
- ii. Gene IX- Lewin.[pg. 256-293, 300-325, 331, 609-667]

## Unit III –

- i. Genetics: A Conceptual Approach, 3<sup>rd</sup> Edition by Benjamin Pierce [pg. 579, 584-588, 593-595]
- ii. iGenetics- Russel [pg. 681-704, 216,217, 169,170]
- iii. Gene X – Lewin [pg. 488-491]

## Unit IV-

- i. Molecular Biology by R. F. Weaver (chapter 5) 96-133
- ii. Snustad [pg. 548-559]
- iii. Pierce [Chapter 25]
- iv. Russel [Chapter 22]
- v. Klug [pg 639-650]

### **LIST OF REFERENCES FOR MICROBIAL GENTEICS.**

1. Watson, Baker, Bell, Gann, Levine, Losick, “**Molecular Biology of the Gene**”, Fifth Edition, Pearson Education (LPE)
2. Trun, Trempy, “**Fundamental Bacterial Genetics**”, Blackwell Publishing
3. Russell, P.J., “**iGenetics- A Molecular Approach**”, Third Edition, Pearson International Edition
4. Snustad & Simmons, “**Principals of Genetics**”, Third Edition, John Wiley & Sons Inc
5. Watson, Gilman, Witkowski, Zoller, “**Recombinant DNA**”, Second Edition, Scientific American Books
6. Klug & Cummings, “**Concepts of Genetics**”, Seventh Edition, Pearson Education (LPE)
7. Pierce, B.A., “**Genetics- A Conceptual Approach**”, Second Edition, W. H. Freeman & Co
8. Lewin, B., “**Genes-IX**”, Jones and Bartlett Publishers

## PSMB-103 Microbial Biochemistry

### THEORY: SEMESTER –I

Course Code	Unit	Topic Headings	Credits	L/ Sem
PSMB-103 Microbial Biochemistry	I	<b>AQUEOUS SOLUTIONS AND ACID BASE CHEMISTRY</b>  1.1. Various units of expressing and inter-converting concentration of solutions: molarity, moles, normality, osmolarity, molality, mole fraction 1.2. Bronsted Concept of conjugate acid –conjugate base pairs, ionization of solutions, pH, titration curves, buffers: preparation, action and their use in Biology 1.3 Henderson-Hasselbalch equation , buffer capacity, polyproteic acids, amphoteric salts, ionic strengths  (problem solving under all heads)	4	15
	II	<b>BIOORGANIC MOLECULES</b> 2.1. Amino acids: Classification and stereochemistry, biochemical information form amino acid sequence, derivative, ionization 2.2. Structure and function of i. Proteins: Structure of peptide bond, stability of formation of peptide bond, Ramchandran plot, protein structure, factors determining secondary , tertiary structures: amino acid sequence, thermodynamics of folding, role of disulfide bonds, dynamics of globular protein folding, chaperonins and prions motifs and domains, protein families, protein stability prediction of secondary and tertiary structure, protein-protein interactions, ii. Glycobiology: Carbohydrates, stability of glycosidic bond, glycoconjugates, proteoglycans, glycoproteins, glycolipids, homopolysaccharide folding, functions of oligosaccharides, iii.: Lipids: Lipid classification, structure of lipids in membranes- glycerolipids, ether lipids, galactolipids, sulfolipids, lipids in archaeobacteria, sphingolipids, terpenes, isoprenoids, Functions of lipids- signals, cofactors, pigments		05
				05
			05	
			15	
	02			
07				
03				
03				
III	<b>METABOLISM OF ONE AND TWO CARBON COMPOUNDS</b> 3.1. Metabolism of one carbon compounds: i. methylotrophs: Oxidation of methane, methanol, methylamines and carbon assimilation in methylotrophic bacteria and yeasts ii. Methanogens: Methanogenesis form H <sub>2</sub> , CO <sub>2</sub> , CH <sub>3</sub> OH, HCOOH, methylamines, energy coupling and biosynthesis in methanogenic bacteria	15	15	
03				
	02			
	02			



	iii. Acetogens: autotrophic pathway of acetate synthesis and CO <sub>2</sub> fixation, iv. Carboxidotrophs: Biochemistry of chemolithoautotrophic metabolism v. Cynogens and cynthotrophs: cynogenesis and cynide degradation  3.2. Metabolism of two- carbon compounds i. Acetate-TCA and Glyoxylate cycle, modified citric acid cycle, carbon monoxide dehydrogenase pathway and disproportionation to methane ii. Ethanol- acetic acid bacteria iii. Glyoxylate and glycollate- dicarboxylic acid cycle, glycerate pathway, beta hydroxyaspartate pathway iv. Oxalate- as carbon and energy source	02 02  01  01 01  01
IV	<b>TRANSFER OF BIOMOLECULES</b> 4.1. Protein transport: extracellular protein secretion, drug export system 4.2. Biological membranes and transport 4.3. Folding of periplasmic proteins, translocation of folded proteins,	15 05 05 05

**PRACTICAL-(PSMBP-103): SEMESTER –I**

Course Code	Topic Headings	Credits	L/ Week
<b>PSMBP-103            MICROBIAL            BIOCHEMISTRY            ( 60 CONTACT HOURS)</b>	<b>AQUEOUS SOLUTIONS AND ACID BASE CHEMISTRY</b> 1. Preparation of buffers 2. Determination of pK and PI value for an amino acid <b>BIOORGANIC MOLECULES</b> 3. Extraction of total lipids 4. Isolation of cholesterol and lecithin from egg yolk 5. Identification of fatty acids and other lipids by TLC 6. Determination of degree of unsaturation of fats and oils 7. Isolation of lactose from bovine milk 8. Estimation of total sugars by phenol-sulphuric acid method 9. Isolation of glutamic acid from gluten 10. Determination of molar absorption coefficient ( $\epsilon$ ) of l-tyrosine 11. Determination of the isoelectric point of the given protein 12. Estimation of polyphenols/ tannins by Folin- Denis method <b>METABOLISM OF ONE AND TWO CARBON COMPOUNDS</b> 13. Enrichment, isolation and identification of <i>Methylobacterium</i> <b>TRANSFER OF BIOMOLECULES</b> 14. Diffusion studies of molecules across sheep RBCs 15. Preparation of liposomes	2	04

## REFERENCES:

### Theory:

Unit I: Biochemical calculations , Segel I.R., John Wiley and Sons, 1995

Unit II: Biochemistry 3rd edition, Mathew, Van Holde and Ahern , Pearson Education

Principles of Biochemistry, 4th edition, Zubay, G., Wm.C. Brown Publishers, 1998

Principles of Biochemistry, Lehninger A.L., Cox and Nelson, CBS publishers and Distributors Pvt. Ltd. 1994

Unit III: Microbial Biochemistry by GN Cohen-2011, Springer

Biotechnology H.J. Rehm and G. Reed (ed.), Volume 6a. Biotransformations, Verlag and Chemie, 1984

Bacterial metabolism by Gottschalk, Springer-Verlag, 1985

Unit IV: Biochemistry , 4<sup>th</sup> edition , Voet D. and Voet J.G., John Willey and Sons Inc., 1995

### Practical:

a. Laboratory manual in biochemistry by Jayaraman J. , New Age International Publishers

b. An introduction to practical biochemistry 3<sup>rd</sup> edition, David T Plummer, Tata McGraw Hill edition 1998

c. Experimental biochemistry –A student companion, Rao Beedu, S. Deshpande, IK international Pvt. Ltd.

d. Laboratory manual in biochemistry, Immunology and Biotechnology, Nigam A and Ayyagiri A. Tata McGraw Hill edition

e. Source of Experiments for teaching Microbiology, Primrose and Wardlaw

f. Microbial Physiology and Biochemistry Laboratory manual: A quantitative approach , David White

g. Principles and techniques of practical biochemistry, 4<sup>th</sup> edition, Wilson K. and Walker J.( Ed.) Cambridge University Press, 1994

## SEMESTER I

Course Code: PSMB-104

Course Code	Unit	Topic Headings	Credits	L / Week
PS MB-104 Medical Microbiology &	I	Advances in medical Microbiology : (15 L) 1.1 Emerging Diseases :- Detailed Study of following infections including Etiology, Transmission, Pathogenesis, Clinical Manifestations, Lab.	4	01

Immunology		<b>diagnosis, Prophylaxis, and Treatment:--</b> <b>AIDS , MOTT (mycobacteria other than TB) Legionellosis,</b> <b>Chicken guenica, Cholera caused by V.cholerae</b> <b>0139,Conditions caused by Helicobactor pyolari, SARS.</b>		
	II	<b>Epidemiology of infectious diseases : (15 L)</b> <b>2.1 Historical aspects-definition</b> <b>2.2 Descriptive Epidemiology-aims and uses</b> <b>2.3 Host parasite interactions in the cause of diseases</b> <b>2.4 Epidemiological principals in prevention and control of Diseases</b> <b>2.5 Measures of risks : frequency measures, morbidity frequency measures, mortality frequency measures natality(birth) measures, measures of association, measures of public health impact.</b> <b>2.6 Public health surveillance: purpose and characteristics , identifying health problems for surveillance, collecting data for surveillance, analyzing and interpreting data, disseminating data and interpretation, evaluating and improving surveillance.</b>		01
	III	<b>Immune system and health part I; (15 L)</b> <b>3.1 Immune response to infectious diseases:--</b> <b>a) Immune response to Prions,</b> <b>b) Immune response to viral infections- HIV/AIDS-HIV and the immune system-Influenza-AvianH5N1.</b> <b>c) Immune response to Bacterial diseases- Difference in the Immune response to extracellular and intracellular bacteria : Diphtheria, Tuberculosis</b>		01

		<b>d) Microbial ways of evading immune system.</b>		
	<b>IV</b>	<p><b>Recent advances in immunology: Immuno biology (15 L)</b></p> <p><b>4.1 Recent advances in Innate immunity</b> including receptors involved and signaling system. Physiological &amp; immunological barriers.</p> <p><b>4.2 the cellular players</b> :Phagocytic cells, Lymphocytic cells, DCs.</p> <p><b>4.3 The innate immune response:</b> Inflammation, Acute Phase Reaction</p> <p><b>4.4 Molecular basis of diversity of immunoglobulin molecules.</b></p> <p><b>4.5 Multigene organization of Ig genes.</b></p> <p><b>4.6 Variable-Region Gene Rearrangements.</b></p> <p><b>4.7 Mechanim of Variable-Region DNA Rearrangements.</b></p> <p><b>4.8 Generation of antibody diversity.</b></p> <p><b>4.9 Manipulations of the immune response.</b></p>		01

## SEMESTER I PRACTICALS (PSMBP-104)

**Problem solving exercises in medical microbiology based on diseases caused by- HIV, MOTT, Chickengunia, Helicobacter, Vibrio cholerae 0139.**

**Diagnosis for HIV**

**1.CD4 lymphocyte count for AIDS**

**2.ELISA for AIDS,**

**Diagnosis for MOTT**

**3.Acid fast staining for MOTT**

**4.Mono - Spot Test for diagnosis of Chickengunia (Demonstration expt.)**

**Diagnosis for V.c.0139**

**5.Cholera red test, String test, Oxidase test, Biochemical tests, & isolation on TCBS medium for identification of Vibrio cholerae 0139.**

**6.serological diagnosis for V.c.0139 using specific monotypic antisera**

**Diagnosis for Helicobacter pylori**

**7..HPSA (Helicobacter pylori ) detection from stool sample. (Demonstration expt.) (kit method)**

**8..Study of virulence factors-Phagocytosis & Phagocytic index**

**9.Collection of human blood & separation of mononuclear cells by ficoll hypaque density gradient centrifugation,**

**10. Counting of viable cells by trypan blue.**

**11.For internal assessment:**

**Case study for epidemiology of the diseases included in unit I (Theory)- students have to collect data and interpret. This can be done from Net or approaching NGO,s "SEHAT".**

**Collection of data, criteria, methodology etc. Assignment to be submitted.**

### References:-

#### Unit I

1. Clinics in laboratory medicine, Emerging Infections and their causative agents. September 2004 vol. 24 no. 3.
2. Textbook of Microbiology 8<sup>th</sup> edition 2009-Ananthnarayan & Paniker-University press

#### Unit II

1. Principles of epidemiology in public health practices 3<sup>rd</sup> edition ([www.cdc.gov/training/products/ss1000](http://www.cdc.gov/training/products/ss1000))
2. Basic lab methods in medical bacteriology, WHO Geneva.
3. Medical laboratory technology by Godkar.

4. **Handbook of Epidemiology- W. Ahrens, I. Pigeot Springer- Verlag Berlin Herdelberg (2005).**
5. **Epidemiology for Public Health Practice- Robert H Friis & Thomas A. Sellers 3<sup>rd</sup> edition- Jones & Bartlett publishers.**
6. **Textbook of preventive and Community medicine- Park & Park.**
7. **Infectious disease surveillance by Nikuchia Nikanatha Blackwell Publishing 2005.**

#### **Unit III**

1. **Immunology – Essential and Fundamental, Sulabha Pathak and Urmi Palan. 3<sup>rd</sup> edition Capital publishing company.**
2. **Immunology- Kuby 6<sup>th</sup> edition W. H. Freeman and company- New York.**
3. **The Elements of immunology- Fahim Halim Khan- Pearson Education.**
4. **Immunology an introduction- 4<sup>th</sup> edition- Ian R. Tizard-Thomson.**

#### **Unit IV**

1. **Immunology – Essential and Fundamental, Sulabha Pathak and Urmi Palan. 3<sup>rd</sup> edition Capital publishing company.**
2. **Immunology- Kuby 6<sup>th</sup> edition W. H. Freeman and company- New York.**
3. **The Elements of immunology- Fahim Halim Khan- Pearson Education.**
4. **Immunobiology –the immune system in health and disease 6<sup>th</sup> ed.-Janeway.Travers.GS.**

#### **References for Practicals:**

1. **Medical laboratory technology- by Godkar.**
2. **Immunology-Essential & Fundamental-Sulbha Phatak & Urmi Palan-3rd edition Capital Publishing Company.**
3. **Clinical immunology – Principle & Practice 3rd ed. 2008 (Part -11 –clinical diagnostic immunology)**
4. **Bailey & Scott’s – diagnostic microbiology 11th edition – Betty Forbes.**
5. **Koneman’s Color Atlas & Text book of Diagnostic Microbiology 6th ed.**

## Semester II Detail Syllabus

### PSMB-201

Course Code	Title	Credits
PSMB-201	Cell Biology & Virology (60L)	04
Unit I:	(15L) <b>VIROLOGY (Animal Viruses)</b>	
	<p><b>1.1 Animal Viruses : Influenza viruses : Classification, Clinical features, replication, genetic variation, Treatment and Surveillance (4L)</b></p> <p><b>1.2 Rabies virus, epidemiology, Pathogenesis, Immunity, Management of human rabies, Viral life cycle, genetic variation. (3L)</b></p> <p><b>1.3 Pox virus ; Clinical features, Structure of virus, replication, Vaccinia, orthopox virus, variola virus. (4L)</b></p> <p><b>1.4 Herpes Virus : Clinical signs and symptoms, varicella Zoster virus, Epstein-Barr virus, Cytomegalovirus, Life cycle, laboratory diagnosis, treatment (4L)</b></p>	01
Unit II:	(15L) <b>VIROLOGY IN RELATION TO HUMAN HEALTH</b>	
	<p><b>2.1) Human Immunodeficiency Virus : transmission, epidemiology, life cycle, prevention, Diagnosis.(4L)</b></p> <p><b>2.2) Hepatitis Virus : Clinical features, epidemiology, Laboratory diagnosis, life cycle, Genetic diversity, prevention (3L)</b></p>	01

<p>2.3)New reemerging viruses, Evolution and adaptation, ecological factors, climate variability, human factors- social behavior, exposure to zoonotic diseases, human movement (4L)</p> <p>2.4)Prions and Viroids, - CJD, BSE, Viruses and Cancer – retrovirus, DNA tumor virus, adeno virus, HCC (5L)</p>	
<p><b>Unit : III (15L)</b></p> <p><b>CELL BIOLOGY(Cell division &amp; Cell Cycle)</b></p> <p>3.1Mechanism of cell division : M-phase, Mitosis, Cytokines (3L)</p> <p>3.2 Cell cycle and Programmed cell death : Control system, intracellular control of cell cycle events, Apoptosis, extracellular control of cell growth and apoptosis (5L)</p> <p>3.3 Cell Junctions and cell adhesion : Anchoring, adherence junctions, Desmosomes, Gap junctions, cell-cell adhesion, Cadherins (3L)</p> <p>3.4 Development of multicellular organisms: Animal cell development, <i>Caenorhabditis elegans</i>, <i>Drosophila</i> signaling genes, gradient of nuclear gene regulatory protein, Dpp and Sog set up, Neural development (4L)</p>	<p>01</p>
<p><b>Unit : IV CELL BIOLOGY(Cell Communication) (15L)</b></p> <p>4.1 Germ cells and fertilization, Meiosis, sex determination in mammals, eggs, sperm, fertilization (4L)</p> <p>4.2 Cell communication : Extracellular signal molecules, nitric oxide gas signal, classes of cell-surface receptor proteins (5L)</p> <p>4.3 Signaling through enzyme linked cell surface receptors : Docking sites, Ras , MAP kinase, PI-3 kinase, TGF (3L)</p> <p>4.4 Signaling in plants : Serine / Threonine kinases, role of ethylene, Phytochromes (3L)</p>	<p>01</p>



## **PRACTICALS : PSMBP-201**

### **SEMESTER II (60 Contact Hrs.)**

- 1) Egg inoculation and cultivating animal virus in embryonated egg. Demonstration (04)**
- 2) Cultivation of macrophage cell lines and study of cell viability (06)**
- 3) Study of Mitosis. (06)**
- 4) Study of Meiosis (06)**
- 5) Estimation of NO (Nitric Oxide) produced by Macrophages. (08)**
- 6) Study of Phagocytosis using bacterial culture / yeast cells (04)**
- 7) Study of Cell membrane integrity using uptake of neutral red. (04)**
- 8) Writing Research Paper –w.r.t. Techniques used to study cell cycle. (06)**
- 9) Review on Cell – Cell communication. (06)**
- 10) Assignment on Animal viruses – Epidemiology, Transmission (06)**
- 11) Presentation of Assignment – Cell Biology (04)**

### **REFERENCES :**

- 1) General Virology – Luria**
- 2) Introduction to Plant Virology – BOS, I. Longman, London, NY.**
- 3) Animal Virology – Fenner and White. Academic Press. NY**
- 4) Chemistry of Viruses – Knight C. Springer Verlag. NY**
- 5) Virology – Delbecco and Giasberg. Harper and Ravi Pub. NY.**
- 6) Bacterial and Bacteriophage Genetics – Edward Birge**
- 7) Microbial and Plant Protoplasts – Perberely**
- 8) Principles of Virology – Flint, Enquist, Racaniello and Skalka, Vol I & II. ASM,**
- 9) Understanding Viruses – Teri Shors. Jones and Bartlett pub.**
- 10) Molecular Biology of The Cell – Albert, Johnson, Lewis, Raff, Roberts and Walter.**
- 11) Molecular Cell Biology. Lodish , Birk, and Zipursky. Freeman**

12) The Structure and Dynamics of Cell Membrane. – Lipowsky and Sackmann. Elsevier.

13) Cell Movements : from Molecules to Motility- Bray Garland Pub. NY.

Course code: PSMB-202

(Microbial Genetics)

Semester II

Course Code	Title	Credits
PSMB-202	Microbial Genetics (60L)	04
Unit I Viral genetics, gene transfer [15L] 1.1 Viral genetics [5L]		01
<b>A. Mapping the Bacteriophage genome.</b> <ul style="list-style-type: none"> <li>i. Phage phenotypes</li> <li>ii. Genetic recombination in phages</li> <li>iii. Genetic fine structure mapping</li> <li>iv. Deletion mapping</li> </ul>		
<b>B. Genes within genes : Bacteriophage <math>\Phi</math> X174</b>		01
<b>C. Constructing phage vectors- phage display vectors, suicide vectors, combining phage vectors and transposons</b> 1.2 Gene Transfer [10L]		
<b>A. Drug resistance and gene transfer in bacteria.</b>		01
<b>B. Genetic exchange in Bacteria – An overview</b>		
<b>C. Mutant phenotypes in bacteria</b>		01
<b>D. Basic test for transformation, conjugation and transduction</b>		
<b>E. Transformation:</b> <ul style="list-style-type: none"> <li>i. The transforming principle</li> <li>ii. Natural competency</li> <li>iii. Process of natural transformation- <i>Bacillus subtilis</i> (in detail)</li> <li>iv. Overview of transformation in <i>Streptococcus pneumoniae</i> &amp; <i>Haemophilus influenza</i></li> <li>v. Artificial transformation</li> </ul>		01

<ul style="list-style-type: none"> <li>vi. Transformation and gene mapping</li> </ul> <p><b>F. Conjugation:</b></p> <ul style="list-style-type: none"> <li>i. Discovery of conjugation</li> <li>ii. F factors and R factors</li> <li>iii. The conjugation machinery and transfer of DNA</li> <li>iv. F<sup>+</sup> X F<sup>-</sup> mating</li> <li>v. Hfr formation and conjugation</li> <li>vi. Formation of F primes and transfer from one cell to another</li> <li>vii. Genetic uses of F'</li> <li>viii. Gene mapping using Hfr crosses and 50% rule.</li> <li>ix. Mapping closely linked genes</li> <li>x. Mobilization of nonconjugable plasmids by</li> <li>xi. Conjugation from prokaryotes to eukaryotes</li> </ul> <p><b>G. Transduction:</b></p> <ul style="list-style-type: none"> <li>i. Discovery</li> <li>ii. Generalized transduction</li> <li>iii. P1 as model of generalized transduction</li> <li>iv. Specialized transduction- λ phage as model system</li> <li>v. LFT &amp; HFT lysate Making merodiploids with specialized transducing phage Moving mutations from plasmids to specialized transducing phage to chromosome</li> </ul>	
<p><b>Unit II: Transposable genetic elements, genetic basis of cancer(15L)</b></p> <p><b>2.1 Transposable genetic elements [6L]</b></p> <ul style="list-style-type: none"> <li><b>A. Transposable Elements in Prokaryotes : An Overview</b> The medical Significance of Bacterial Transposons</li> <li><b>B. Transposable Elements in Eukaryotes</b> Ac and Ds Elements in Maize P Elements and Hybrid Dysgenesis in Drosophila Mariner, an Ancient and Widespread Transposon</li> <li><b>C. Retrotransposons</b> Retroviruslike Elements Retroposons</li> <li><b>D. The Genetic and Evolutionary Significance of Transposable Elements</b></li> </ul>	<p><b>01</b></p>

<p> <b>Transposons and Genome Organization</b>  <b>Transposons and Mutation</b>  <b>Rearrangement of Immunoglobulin Genes</b>  <b>Evolutionary Issues Concerning Transposable Elements</b> </p> <p> <b>2.2 Genetic basis of cancer [9L]</b>  <b>A. A Common Killer</b>  <b>B. Cancer: A Genetics Disease</b>  <b>The Many Forms of Cancer</b>  <b>Cancer and the Cell Cycle</b>  <b>A Genetics Basis for Cancer</b> </p> <p> <b>C. Oncogenes</b>  <b>Tumor-Inducing Retroviruses and Viral Oncogenes</b>  <b>Cellular Homologs of Viral Oncogenes: The Proto-Oncogenes</b>  <b>Mutant Cellular Oncogenes and Cancer</b>  <b>Chromosome Rearrangement and Cancer</b> </p> <p> <b>D. Tumor Suppressor Genes</b>  <b>Inherited Cancers and Knudson’s Two-Hit Hypothesis</b>  <b>Cellular Roles of Tumor Suppressor Proteins</b> </p> <p> <b>E. Genetic Pathways to Cancer</b> </p>	
<p> <b>Unit III: Developmental genetics (15L)</b> </p> <p> <b>3.1 Developmental genetics [5L]</b>  <b>A. Cloning Experiments</b>  <b>B. The Genetics of Pattern Formation in Drosophila</b>  <b>C. Homeobox Genes in other Organisms</b>  <b>D. The Genetics of Flower Development in Arabidopsis</b>  <b>E. Programmed Cell Death in Development</b>  <b>F. Evo-Devo: The Study of Evolution and Development</b> </p> <p> <b>3.2The genetic control of animal development [10L]</b>  <b>A. Stem Cell Therapy: A Brave New World?</b>  <b>B. The Process of Development in Animals</b>  <b>i. Oogenesis and fertilization</b>  <b>ii. The Embryonic Cleavage Divisions and Blastula Formation</b> </p>	<p style="text-align: center;"><b>01</b></p>

<ul style="list-style-type: none"> <li>iii. <b>Gastrulation and Morphogenesis</b></li> <li><b>C. Genetic Analysis of Development in Model Organisms</b> <ul style="list-style-type: none"> <li>i. <b>Drosophila as a Model Organism</b></li> <li>ii. <b>Caenorhabditis as a model organism</b></li> </ul> </li> <li><b>D. Genetic Analysis of Development Pathways</b> <ul style="list-style-type: none"> <li>i. <b>Sex Determination in Drosophila</b></li> <li>ii. <b>Sex Determination in Caenorhabditis</b></li> </ul> </li> <li><b>E. Molecular Analysis of Genes Involved in Development</b></li> <li><b>F. Maternal Gene Activity in Development</b> <ul style="list-style-type: none"> <li>i. <b>Maternal-Effect Genes</b></li> <li>ii. <b>Determination of the Dorsal-Ventral and Anterior-Posterior Axes in Drosophila Embryos</b></li> </ul> </li> <li><b>G. Zygotic Gene Activity in Development</b> <ul style="list-style-type: none"> <li>i. <b>Body Segmentation</b></li> <li>ii. <b>Specification of Cell Types</b></li> <li>iii. <b>Organ Formation</b></li> </ul> </li> </ul>	
<p><b>Unit IV: Applications and ethics of genetic technology [15L]</b></p> <p><b>4.1 Mapping Human Genes at the Molecular Level</b></p> <p><b>RFLPs as Genetic Markers</b></p> <p><b>Linkage Analysis Using RFLPs</b></p> <p><b>Positional Cloning: The Gene for Neurofibromatosis</b></p> <p><b>The Candidate Gene Approach: The Gene for Marfan Syndrome</b></p> <p><b>Fluorescent in Situ Hybridization (FISH) Gene Mapping</b></p> <p><b>4.2 Genetic Disorders: Diagnosis and Screening</b></p> <p><b>Prenatal Genotyping for Mutations in the <math>\beta</math>- Globin Gene</b></p> <p><b>Prenatal Diagnosis of sickle-Cell Anemia</b></p> <p><b>Single Nucleotide Polymorphisms and Genetic Screening</b></p> <p><b>DNA Microarrays and Genetic Screening</b></p> <p><b>Genetic Testing and Ethical Dilemmas</b></p> <p><b>4.3 Treating Disorders with Gene Therapy</b></p> <p><b>Gene Therapy for Severe Combined Immunodeficiency (SCID)</b></p> <p><b>Problems and Failures in Gene Therapy</b></p>	<p><b>01</b></p>

<p><b>The Future of Gene Therapy: New Vectors and Target-Cell Strategies</b></p> <p><b>Ethical Issues and Gene Therapy</b></p> <p><b>4.4 DNA Fingerprints</b></p> <p><b>Minisatellites (VNTRs) and Microsatellites (STRs)</b></p> <p><b>Forensic Applications of DNA Fingerprints</b></p> <p><b>4.5 Genome Projects Use Recombinant DNA technology</b></p> <p><b>The Human Genome Project: An overview</b></p> <p><b>The Ethical, Legal, and Social Implications (ELSI) Program</b></p> <p><b>After the Genome Projects</b></p> <p><b>4.6 Biotechnology is an Outgrowth of Recombinant DNA Technology</b></p> <p><b>Insulin Production by Bacteria</b></p> <p><b>Transgenic Animal Hosts and Pharmaceutical Products</b></p> <p><b>Transgenic Crop Plants and Herbicide Resistance</b></p> <p><b>4.7 Marshalling recombinant DNA technology to fight AIDS</b></p>	
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## SEMESTER II

### PRACTICALS : PSMBP- 202 (60 Contact Hrs)

#### List of practicals for semester II

- 1) Transformation
- 2) Conjugation, zygotic induction
- 3) Transduction
- 4) Identification of phage nucleic acid
- 5) Curing of plasmids
- 6) Study of transposable elements
- 7) Isolation of host range mutants
- 8) Problems on gene transfer mechanisms
- 9) Problems on viral genetics
- 10) Cancer genetics- visit to ACTREC

#### References:

#### Unit I:

- i. Principles of Genetics, Third edition by D. Peter Snustad & Michael J. Simmons  
[pg 396 – pg 414]

- ii. **Fundamental Bacterial Genetics** by Nancy Trun and Janine Trempy – chapters 8, 10 and 11.
- iii. **Snustad and Simmons 3<sup>rd</sup> edition** [pg 418 – 435]

**Unit II:**

- i. **Principles of Genetics, Third edition** by D. Peter Snustad & Michael J. Simmons [pg 440-458, 695-704]

**Unit III:**

- i. **Genetics, Second edition** by Benjamin A. Pierce [pg. 608-619]
- ii. **Principles of Genetics, Third Edition** by D. Peter Snustad & Michael J. Simmons [ 629- 648]

**Unit IV:**

- i. **Concept of Genetics, Seventh Edition** by William S. Klug & Michael R. Cummings [pg 524-540]
- ii. **Recombinant DNA** by J.D. Watson (2<sup>nd</sup> edition) [pg 486-504]

## **LIST OF REFERENCES FOR MICROBIAL GENTEICS.**

1. **Watson, Baker, Bell, Gann, Levine, Losick, “Molecular Biology of the Gene”, Fifth Edition, Pearson Education (LPE)**
2. **Trun, Trempy, “Fundamental Bacterial Genetics”, Blackwell Publishing**
3. **Russell, P.J., “iGenetics- A Molecular Approach”, Third Edition, Pearson International Edition**
4. **Snustad & Simmons, “Principals of Genetics”, Third Edition, John Wiley & Sons Inc**
5. **Watson, Gilman, Witkowski, Zoller, “Recombinant DNA”, Second Edition, Scientific American Books**
6. **Klug & Cummings, “Concepts of Genetics”, Seventh Edition, Pearson Education (LPE)**
7. **Pierce, B.A., “Genetics- A Conceptual Approach”, Second Edition, W. H. Freeman & Co**
8. **Lewin, B., “Genes-IX”, Jones and Bartlett Publishers**

**PSMB-203 Microbial Biochemistry**

**THEORY: SEMESTER –II**

Course Code	Unit	Topic Headings	Credits	L/ Sem
PSMB-203 Microbial Biochemistry	I	<b>ANALYTICAL BIOCHEMISTRY</b>  <b>1.1. Determination of molecular weights, purity, length and volume of organic compounds</b> <b>1.2. Extraction, purification, application and analysis of proteins, carbohydrates and lipids.</b> i. General methods of extraction: salting out, use of organic solvents ii. purification: chromatographic techniques iii. mass determination: ultracentrifuge, GC-MS iv. structure determination: X-ray diffraction, v. location: Confocal spectroscopy <b>1.3. Methods of analysis:</b> i. Proteins, ii. carbohydrates iii. lipids iv. other organic compounds (problem solving under all heads.)	4	15
				02 06
				02 02 02 01
	II	<b>Enzymeology</b> <b>2.1. Enzyme kinetics: Discovery of enzymes, enzyme terminology, basic aspects of chemical kinetics, kinetics of enzyme catalyzed reactions, enzyme inhibition(reversible and irreversible), specific examples – effect of pH on enzyme activity( Fumerase), Enzyme action by X-ray crystallography, nerve gas and its significance, HIV enzyme inhibitors and drug design( Problems solving)</b> <b>2.2. Enzyme regulation: Phosphofructokinase as allosteric enzyme, general properties of asllosteric enzymes, two themes of allosteric regulations, regulation by covalent modification, regulation by multienzyme complexes and multifunctional enzymes, specific example- the blood coagulation cascade (problem solving)</b> <b>2.3. Mechanisms of enzyme catalysis: five themes that occur in discussing enzymatic reactions, detailed mechanisms of enzyme catalysis for example- serine proteases, ribonucleases, triose phosphate isomerase, lysozyme, lactate and alcohol dehydrogenases, catalytic antibodies ( Problem solving).</b>		15 05  05
	III	<b>SIGNALLING AND STRESS</b> <b>3.1. Introduction to two-component signaling systems:</b>		15 05



		<p>i. Response by facultative anaerobes to anaerobiosis, nitrate and nitrite, nitrogen supply, inorganic phosphate supply</p> <p>ii. Effect of oxygen and light on the expression of photosynthetic genes in purple photosynthetic bacteria, response to osmotic pressure and temperature, response to potassium ion and external osmolarity, response to carbon sources</p> <p>iii. Bacterial response to environmental stress- heat-shock response, repairing damaged DNA, the SOS response, oxidative stress,</p> <p>3.2. Synthesis of virulence factors in response to temperature, pH, nutrient, osmolarity and quorum sensors, chemotaxis, photoresponses, aerotaxis,</p> <p>3.3. Bacterial development and quorum sensing: Myxobacteria, Caulobacter, bioluminescence, systems similar to LuxR/LuxI in nonluminescent bacteria, biofilms.</p>		05
	IV	<p><b>MICROBIAL DEGRADATION</b></p> <p>4.1. Degradation of aromatic and alicyclic compounds- important organisms, use of mixed cultures and manipulation of degradative genes, common pathways of aromatic degradation, aerobic and anaerobic degradation of aromatic compounds, aromatic and heterocyclic compounds with economical and ecotoxicological significance(phenolic pesticides, phthalic acid esters, lignosulphonates, surfactants, dyes and aromatics released during combustion.)</p> <p>4.2. Biotransformation of polycyclic aromatic hydrocarbons( PAHs)- Naphthalene, phenanthrene, anthracene, alicyclic and higher aliphatic hydrocarbons, halogenated aliphatics, branched chain alkanes and alkenes</p> <p>4.3. Biochemical mechanisms of pesticide detoxification</p>		06
				06
				03

**PRACTICAL:(PSMBP—203):**

Course Code	Topic Headings	Credits	L/ Week
PSMBP-203 MICROBIAL BIOCHEMISTRY ( 60 CONTACT HOURS)	<p><b>ANALYTICAL BIOCHEMISTRY</b></p> <p>1. Differential extraction with buffers,</p> <p>2. purification strategy</p> <p>3. Purification and concentration by precipitation- by decrease of pH, decrease in ionic strength, salting out, organic solvents, organic polymers, denaturation</p> <p>4. Aqueous- two phase partitioning</p>	2	04
	<p><b>ENZYMOLGY</b></p> <p>5. purification of an extracellular enzyme( <math>\beta</math>-amylase) by salting out and dialysis</p> <p>6. Enzyme kinetics-effect of enzyme concentration, substrate concentration, pH , temperature and inhibitors on enzyme activity,</p> <p>7. Demonstration of proteolytic activity</p> <p>8. Determination of glucose isomerase present intracellularly in <i>Bacillus sp.</i></p>		

	<b>SIGNALLING AND STRESS</b> 9. Adaptation of <i>E. coli</i> to anaerobiosis 10. Chemotaxis of <i>Pseudomonas</i> 11. Effect of temperature and water activity on swarming of <i>Proteus</i> 12. Different bacteriolytic response associated with addition of lysozyme and salt..		
	<b>MICROBIAL DEGRADATION</b> 13. Microbial degradation of polycyclic aromatic hydrocarbons(PAHs)- enrichment, isolation and screening of bacteria 14. PAH degradation studies 15. Plasmid curing and determination of chemotaxis by drop assay method		

#### REFERENCES:

##### Theory:

Unit I: Biochemistry 3rd edition, Mathew, Van Holde and Ahern , Pearson Education

Principles of Biochemistry, 4th edition, Zubey

Principles of Biochemistry, ~~Horton and Moran~~ Scrimgeour Pears Rawn

Principles of Biochemistry, Lehninger A.L., Cox and Nelson, CBS publishers and Distributors Pvt. Ltd. 1994

Unit II: Principles of Biochemistry, Lehninger A.L., Cox and Nelson, CBS publishers and Distributors Pvt. Ltd. 1994

Biochemistry by Conn and Stumph

Unit III: The physiology and biochemistry of prokaryotes , White D., Oxford University Press, 2000

Unit IV: Biotechnology H.J. Rehm and G. Reed (ed.), Volume 6a. Biotransformations, Verlag and Chemie, 1984

Introduction to bacterial metabolism Doelle H.W., Academic Press, 1975

Microbial ecology , Atlas RM and Bartha, Addison Wesley Longman Inc. 1998.

##### Practical:

a. Laboratory manual in biochemistry by Jayaraman J. , New Age International Publishers

b. An introduction to practical biochemistry 3<sup>rd</sup> edition, David T Plummer, Tata McGraw Hill edition 1998

c. Experimental biochemistry –A student companion, Rao Beedu, S. Deshpande, IK international Pvt. Ltd.

d. Laboratory manual in biochemistry, Immunology and Biotechnology, Nigam A and Ayyagiri A. Tata McGraw Hill edition

e. Source of Experiments for teaching Microbiology, Primrose and Wardlaw

f. Microbial Physiology and Biochemistry Laboratory manual: A quantitative approach , David White

g. Principles and techniques of practical biochemistry, 4<sup>th</sup> edition, Wilson K. and Walker J.( Ed.)  
Cambridge University

**SEMESTER II**

**PSMB-204**

Course Code PSMB-204	Unit	Topic Headings	Credits	L / Week
PS MB-204 Medical Microbiology & Immunology	I	<p><b><u>Advances in medical Microbiology :</u> (15 L)</b></p> <p><b>1.1 Emerging Diseases :-</b> Detailed Study of following infections including Etiology, Transmission, Pathogenesis, Clinical Manifestations, Lab. diagnosis, Prophylaxis, and Treatment.</p> <p>Dengue, Listeriosis, VRE (Vancomycin Resistant enterococci)Leptospirosis, Hepatitis non A , Swine flu, conditions caused by Campylobacter , and prions</p>	4	01
	II	<p><b><u>Clinical Research:</u> (15 L)</b></p> <p><b>2.1 Introduction to Clinical Research.</b></p> <p>a. Good Clinical practice Guidelines</p> <p>b. Ethical aspects of Clinical Research</p> <p>c. Regulatory Requirements in clinical research</p> <p>d. Clinical Research Methodologies and Management</p> <p>e. Clinical Data Management and Statistics in Clinical Research.</p> <p><b><u>2.2 Modern Diagnostic Methods:</u></b></p> <p>a) -Advances in Molecular and Immunological Techniques.</p> <p>b) -Microarrays.</p> <p>c) -Advances in Fluorescence Technology.</p>		01
	III	<p><b><u>Immune system and Health : Part -II</u> (15 L)</b></p>		01

	<p><b><u>3.1 Recent advances in immune tolerance</u></b></p> <ul style="list-style-type: none"> <li>a) -Central Tolerance</li> <li>b) -Peripheral Tolerance</li> <li>c) -Tolerance Induction</li> <li>d) -T-cell Tolerance</li> <li>e) -B-cell Tolerance</li> <li>f) -Incomplete Tolerance</li> <li>g) -Duration of Tolerance</li> </ul> <p><b><u>3.2 Recent advances in autoimmunity</u></b></p> <ul style="list-style-type: none"> <li>a) -Interplaying Factors</li> <li>b) -Triggering Factors</li> <li>c) -Mechanisms of Damage</li> <li>d) -Organ Specific Autoimmune Diseases</li> <li>e) -Systemic Autoimmune Diseases</li> <li>f) -Animal Models for Autoimmune Diseases</li> <li>g) -Proposed Mechanisms for Induction of Autoimmunity</li> <li>h) -Treatment of Autoimmune Diseases</li> </ul> <p><b><u>3.3 Transplantation &amp; Transfusion Immunology</u></b></p> <ul style="list-style-type: none"> <li>a) -Antigens Involved in Graft Rejection</li> <li>b) -Allorecognition</li> <li>c) -Graft Rejection-Role of APC's &amp; Effector Cells</li> <li>d) -Graft v/s Host Diseases</li> <li>e) -Immuno Suppressive Therapies</li> <li>f) -Blood Transfusion:-- <ul style="list-style-type: none"> <li>i. ABO &amp; Rh Blood Groups</li> <li>ii. Potential Transfusion Hazards</li> <li>iii. Transfusion Alternatives</li> </ul> </li> </ul> <p><b><u>3.4 Cancer immunology.</u></b></p> <ul style="list-style-type: none"> <li>a) -Cancer:Origin &amp; Terminology</li> <li>b) -Malignant Transformation of Cells</li> <li>c) -Oncogenes &amp; Cancer Induction</li> <li>d) -Tumors of the Immune System</li> </ul>		
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		<ul style="list-style-type: none"> <li>e) -Tumor Antigens</li> <li>f) -Tumor Evasion of the Immune System</li> <li>g) -Cancer Immuno Therapy</li> </ul>		
	IV	<p style="text-align: center;"><b><u>Challenges in immune system (15 L)</u></b></p> <p><b><u>4.1 Recent advances in vaccines</u></b></p> <ul style="list-style-type: none"> <li>a) -Challenges faced</li> <li>b) -HIV</li> <li>c) -Measles</li> <li>d) -T.B.</li> </ul> <p><b><u>4.2 Immunodeficiency diseases</u></b></p> <ul style="list-style-type: none"> <li>a) -Primary Immunodeficiency</li> <li>b) -Defects in the Compliment System</li> <li>c) -Treatment Approaches for Immunodeficiency</li> <li>d) -Animal Models of Primary Immunodeficiency</li> <li>e) -Secondary Immunodeficiency &amp; AIDS</li> </ul> <p><b><u>4.3 Adversarial strategies to overcome immune response</u></b></p> <ul style="list-style-type: none"> <li>a) -microbial strategies in relation to the immune response</li> <li>b) -Inflammation Revisited</li> <li>c) -Protective Response Against Bacteria</li> <li>d) -The Habitat of Intracellular Bacteria</li> <li>e) -Immunity to Fungi</li> <li>f) -Immunity to Parasitic Infection</li> </ul>		01

### SEMESTER II PRACTICALS (PSMBP-204)

Problem solving exercises in medical microbiology with appropriate tests for the diagnosis of diseases :

1.Rapid identification for Dengue virus(IgM &IgG)kit method “TULIP”

Immuno chromatography (Demonstration Experiment )

2.Diagnosis for VRE: Isolation using Bile Esculin agar, PYR test.

3. Diagnosis for VRE: AST.

4. **Diagnosis for VRE: MIC using High Comb MIC Test.**
5. **Diagnosis for Leptospirosis: Spirochaete staining.**
6. **Diagnosis for Hepatitis Non- A:ELISA.**
7. **Diagnosis for Swine flu-H1N1:Heamagglutination & Heamagglutination inhibition test.**
8. **Immuno-electrophoresis of proteins – Human serum**
9. **Determination of ABO & Rh – Antibody titre**
10. **Major & Minor cross matching of blood.**
11. **SRID: For detection of immune deficiency and Complement deficiency.**
12. **Students will have to submit an assignment on clinical trials**

**References:**

**Unit I**

1. **Clinics in laboratory medicine, Emerging Infections and their causative agents. September 2004 vol. 24 no. 3.**
2. **Textbook of Microbiology 8<sup>th</sup> edition 2009-Ananthnarayan & Paniker-University press**
3. **(Some more References to be cited.)**

**Unit II**

**a.**

1. **Textbook of clinical trials- editors David Machim, Simson Day & Sylvan Green-John Wiley & Sons.**
2. **Management of Data in Clinical Trials- Eleanor McFadden M.A. - John Wiley & Sons.**
3. **Clinical Trials- Issues and Approaches- Edited by Stanley H. Shapiro, Thomas A. Louis-Marcel Dekker Inc. New York.**

**b.**

1. **Immunology- Kuby 6<sup>th</sup> edition W. H. Freeman and company- New York.**
2. **The Elements of immunology- Fahim Halim Khan- Pearson Education.**
3. **Immunology an introduction- 4<sup>th</sup> edition- Ian R. Tizard-Thomson.**
4. **Roitt's Essential Immunology 12<sup>th</sup> edition- Wiley- Blackwell.**
5. **Koneman's color Atlas & Textbook of Diagnostic Microbiology 6<sup>th</sup> edition-Lippincott Williams & Wilkins**

### Unit III

a.

1. Immunology- Kuby 6<sup>th</sup> edition W. H. Freeman and company- New York.
2. Immunology-Essential & Fundamental edited by Sulbha Pathak & Urmi Palan-3<sup>rd</sup> edition- Central Publishing Company.
3. Immunology an introduction- 4<sup>th</sup> edition- Ian R. Tizard-Thomson.

b.

1. Immunology- Kuby 6<sup>th</sup> edition W. H. Freeman and company- New York.
2. Immunology-Essential & Fundamental edited by Sulbha Pathak & Urmi Palan-3<sup>rd</sup> edition- Central Publishing Company.
3. Immunology an introduction- 4<sup>th</sup> edition- Ian R. Tizard-Thomson.
4. Roitt's Essential Immunology 12<sup>th</sup> edition- Wiley- Blackwell.
5. The Elements of immunology- Fahim Halim Khan- Pearson Education.
6. Immuno Biology-the immune system in health & disease-6<sup>th</sup> edition-Janeway, Travers-GS.

c.

1. Immunology- Kuby 6<sup>th</sup> edition W. H. Freeman and company- New York.
2. The Elements of immunology- Fahim Halim Khan- Pearson Education.
3. Immunology-Essential & Fundamental edited by Sulbha Pathak & Urmi Palan-3<sup>rd</sup> edition- Central Publishing Company.

d.

1. Immunology- Kuby 6<sup>th</sup> edition W. H. Freeman and company- New York.
2. Immunology-Essential & Fundamental edited by Sulbha Pathak & Urmi Palan-3<sup>rd</sup> edition- Central Publishing Company.
3. Immunology an introduction- 4<sup>th</sup> edition- Ian R. Tizard-Thomson.
4. Roitt's Essential Immunology 12<sup>th</sup> edition- Wiley- Blackwell.
5. The Elements of immunology- Fahim Halim Khan- Pearson Education

### Unit IV

a.

1. Current Published papers on recent advances in relevant vaccines to be referred.

b.

1. Immunology- Kuby 6<sup>th</sup> edition W. H. Freeman and company- New York.
2. Roitt's Essential Immunology 12<sup>th</sup> edition- Wiley- Blackwell.

c.

1. Roitt's Essential Immunology 12<sup>th</sup> edition- Wiley- Blackwell.

2. The Pathogenesis of Infectious Disease- Cedric A . Mims.ELBS.

**References for Practicals:**

1. Medical laboratory technology- by Godkar.

2. Immunology-Essential & Fundamental-Sulbha Phatak & Urmi Palan-3rd edition Capital Publishing Company.

3 Clinical immunology – Principle & Practice 3rd ed. 2008 (Part -11 –clinical diagnostic immunology)

4. Bailey & Scott’s – diagnostic microbiology 11th edition – Betty Forbes.

5. Koneman’s Color Atlas & Text book of Diagnostic Microbiology 6th ed.

**Modality of Assessment:**

**Internal Assessment - 40% 40 marks.**

**a) Theory 40 marks**

Sr No	Evaluation type	Marks
1	Two Assignments/Case study/Project	20
2	One class Test (multiple choice questions / objective)	10
3	Active participation in routine class instructional deliveries(case studies/ seminars//presentation)	05
4	Overall conduct as a responsible student, manners, skill in articulation, leadership qualities demonstrated through organizing co-curricular activities, etc.	05

**b) Practicals : 20 marks**

Sr No	Evaluation type	Marks
1	Two best practicals	10
2	Journal	05
3	Viva	05

**B ) External examination - 60 %**

**Semester End Theory Assessment - 60% 60 marks**

**i. Duration - These examinations shall be of three hours duration.**



ii. Theory question paper pattern :-

1. There shall be five questions each of 12 marks. On each unit there will be one question & fifth one will be based on all the four units .
2. All questions shall be compulsory with internal choice within the questions. Each question will be of 20 to 23 marks with options.
3. Questions may be sub divided into sub questions a, b, c, d & e only & the allocation of marks depends on the weightage of the topic.

**Practical Examination Pattern:**

**Semester I:**

<b>Practical Course :</b>	<b>Internal</b>	<b>External</b>	<b>Total</b>
<b>PSMBP-101</b>	<b>20 marks</b>	<b>30 marks</b>	<b>50 marks</b>
<b>PSMBP-102</b>	<b>20 marks</b>	<b>30 marks</b>	<b>50 marks</b>
<b>PSMBP-103</b>	<b>20 marks</b>	<b>30 marks</b>	<b>50 marks</b>
<b>PSMBP-104</b>	<b>20 marks</b>	<b>30 marks</b>	<b>50 marks</b>

**Semester II:**

<b>Practical Course :</b>	<b>Internal</b>	<b>External</b>	<b>Total</b>
<b>PSMBP-201</b>	<b>20 marks</b>	<b>30 marks</b>	<b>50 marks</b>
<b>PSMBP-202</b>	<b>20 marks</b>	<b>30 marks</b>	<b>50 marks</b>
<b>PSMBP-203</b>	<b>20 marks</b>	<b>30 marks</b>	<b>50 marks</b>
<b>PSMBP-204</b>	<b>20 marks</b>	<b>30 marks</b>	<b>50 marks</b>

**Internal Practical Examination (20 marks)**

<b>Semester I-Internal Practical Examination</b>				
<b>Practical Course :</b>	<b>Journal-Marks</b>	<b>Assignment /Viva Seminar Marks</b>	<b>Pract test-02 Marks</b>	<b>Total</b>
<b>PSMBP-101</b>	<b>05</b>	<b>05</b>	<b>10</b>	<b>20</b>
<b>PSMBP-102</b>	<b>05</b>	<b>05</b>	<b>10</b>	<b>20</b>
<b>PSMBP-103</b>	<b>05</b>	<b>05</b>	<b>10</b>	<b>20</b>

<b>PSMBP-104</b>	<b>Semester II-05</b>	<b>Internal Practical-05</b>	<b>Examination-10</b>	<b>20</b>
<b>Practical Course :</b>	<b>Journal-Marks</b>	<b>Assignment /Viva Seminar Marks</b>	<b>Pract test-02 Marks</b>	<b>Total</b>
<b>PSMBP-201</b>	<b>05</b>	<b>05</b>	<b>10</b>	<b>20</b>
<b>PSMBP-202</b>	<b>05</b>	<b>05</b>	<b>10</b>	<b>20</b>
<b>PSMBP-203</b>	<b>05</b>	<b>05</b>	<b>10</b>	<b>20</b>
<b>PSMBP-204</b>	<b>05</b>	<b>05</b>	<b>10</b>	<b>20</b>

### Overall Examination Pattern

#### Semester I

Co urs	PSMB-101			PSMB-102			PSMB-103			PSMB-104			Grand Total
	Int er nal	Ext er nal	To tal	Int er nal	Ext er nal	To tal	Int er nal	Ext er nal	To tal	Int er nal	Ext er nal	To tal	
<b>The ory</b>	<b>40</b>	<b>60</b>	<b>100</b>	<b>40</b>	<b>60</b>	<b>100</b>	<b>40</b>	<b>60</b>	<b>100</b>	<b>40</b>	<b>60</b>	<b>100</b>	<b>400</b>
<b>Pra ctic als</b>	<b>20</b>	<b>30</b>	<b>50</b>	<b>20</b>	<b>30</b>	<b>50</b>	<b>20</b>	<b>30</b>	<b>50</b>	<b>20</b>	<b>30</b>	<b>50</b>	<b>200</b>

#### Semester II

Course	PSMB-201			PSMB-202			PSMB-203			PSMB-204			Grand Total
	Int er nal	Ext er nal	To tal	Int er nal	Ext er nal	To tal	Int er nal	Ext er nal	To tal	Int er nal	Ext er nal	To tal	
<b>Theory</b>	<b>40</b>	<b>60</b>	<b>100</b>	<b>40</b>	<b>60</b>	<b>100</b>	<b>40</b>	<b>60</b>	<b>100</b>	<b>40</b>	<b>60</b>	<b>100</b>	<b>400</b>
<b>Practic als</b>	<b>20</b>	<b>30</b>	<b>50</b>	<b>20</b>	<b>30</b>	<b>50</b>	<b>20</b>	<b>30</b>	<b>50</b>	<b>20</b>	<b>30</b>	<b>50</b>	<b>200</b>

