

**AC 19/9/2013**  
**Item no. 4.13**

# **UNIVERSITY OF MUMBAI**



## **Syllabus for the Bridge Course In Microbiology**

**(Credit Based Bridge Course in Microbiology with effect from  
the academic year 2014–2015)**

**Program: Bridge Course**  
**Course: Microbiology**  
**Credit assignment**

<b>Paper No. And Course Code</b>	<b>Unit no.</b>				<b>Number of lectures</b>	<b>credits</b>
BCMB-1 (Microbial Genetics, Bioinformatics and Medical Microbiology)	I	II	III	IV	60	06
BCMB-2 (Microbial Biochemistry and Bioprocess Technology)	I	II	III	IV	60	06

## Bridge Course in Microbiology: General Outline

Course code	Title	Credits and Lectures
<b>BCMB-1</b>	<b>MICROBIAL GENETICS, BIOINFORMATICS AND MEDICAL MICROBIOLOGY</b>	<b>06 credits (60 LECTURES)</b>
Unit I	CLASSICAL GENETICS	15 lectures
Unit II	BASIC TECHNIQUES & BIOINFORMATICS	15 lectures
Unit III	CHEMOTHERAPY	15 lectures
Unit IV	IMMUNE SYSTEM IN HEALTH AND DISEASES	15 lectures
<b>BCMB-2</b>	<b>MICROBIAL BIOCHEMISTRY AND BIOPROCESS TECHNOLOGY</b>	<b>06 credits (60 LECTURES)</b>
Unit I	BIOENERGETICS	15 lectures
Unit II	METABOLIC REGULATION	15 lectures
Unit III	QUALITY ASSURANCE AND BIOINSTRUMENTATION	15 lectures
Unit IV	BIOTECHNOLOGICAL PRODUCTS AND REGULATORY PRACTICES	15 lectures

## Bridge Course In Microbiology: Detail Syllabus

Course Code	Title	Lectures
<b>BCMB-1</b>	<b>MICROBIAL GENETICS, BIOINFORMATICS AND MEDICAL MICROBIOLOGY</b>	<b>06 credits (60 LECTURES)</b>
<b><u>Unit I</u></b> <b><u>Classical Genetics</u></b>		<b><u>15 Lectures</u></b> <b>(1.5 Credits)</b>
<b>1.1. Branches of Genetics</b> 1.1.a. Transmission genetics 1.1.b. Molecular genetics 1.1.c. Population genetics 1.1.d. Quantitative genetics		<b>1 Lecture</b>
<b>1.2. Model Organisms</b>  1.2.a. Characteristics of a model organism 1.2.b. Examples of model organisms used in study 1.2.c. Examples of studies undertaken using prokaryotic and eukaryotic model organisms.		<b>1 Lecture</b>
<b>1.3. Plasmids</b> 1.3.a. Physical nature 1.3.b. Detection and isolation of plasmids 1.3.c. Plasmid incompatibility and Plasmid curing 1.3.d. Cell to cell transfer of plasmids 1.3.e. Types of plasmids <ul style="list-style-type: none"> <li>i. Resistance Plasmids,</li> <li>ii. Plasmids encoding Toxins and other Virulence Characteristics</li> <li>iii. col factor</li> <li>iv. Degradative plasmids</li> </ul>		<b>5 Lectures</b>
<b>1.4. Transposable Elements in Prokaryotes</b>  1.4.a. Insertion sequences 1.4.b. Transposons <ul style="list-style-type: none"> <li>i. Types</li> <li>ii. Structure and properties</li> <li>iii. Mechanism of transposition</li> <li>iv. Transposon mutagenesis</li> </ul> 1.4.c. Integrons		<b>3 Lectures</b>
<b>1.5. Recombination in bacteria</b> 1.5.a. General/Homologous recombination <ul style="list-style-type: none"> <li>i. Molecular mechanism</li> <li>ii. Holliday model of recombination</li> </ul> 1.5.b. Site –specific recombination		

<p><b><u>Unit II</u></b></p> <p><b><u>Basic Techniques &amp; Bioinformatics</u></b></p> <p><b>2.1. Basic techniques</b>  2.1.a. Southern, Northern and Western blotting.  2.1.b. Autoradiography</p> <p><b>2.2. Screening and selection methods for identification and isolation of recombinant cells</b></p> <p><b>2.3. PCR-</b> basic PCR and different types of PCR (Reverse transcriptase PCR, Real time quantitative PCR )</p> <p><b>2.4. Bioinformatics</b>  2.4.a. Introduction <ul style="list-style-type: none"> <li>i. Definition, aims, tasks and applications of Bioinformatics.</li> <li>ii. Database, tools and their uses - <ul style="list-style-type: none"> <li>➤ Importance, Types and classification of databases</li> <li>➤ Nucleic acid sequence databases- EMBL, DDBJ, GenBank, GSDB, Ensembl and specialized Genomic resources.</li> <li>➤ Protein sequence databases-PIR, SWISS-PROT, TrEMBL, NRL-3D. Protein structure databases-SCOP, CATH, PROSITE, PRINTS and BLOCKS. KEGG.</li> </ul> </li> </ul> </p> <p>2.4.b. Brief introduction to Transcriptome, Metabolomics, Pharmacogenomics, Phylogenetic analysis, Phylogenetic tree, Annotation,</p> <p>2.4.c. Sequence alignment-- global v/s local alignment, FASTA, BLAST.</p> <p>2.4.d. Genomics- structural, functional and comparative genomics.</p> <p>2.4.e. Proteomics- structural and functional proteomics.</p>	<p><b><u>15 Lectures</u></b> <b>(1.5 Credits)</b></p> <p><b>3 Lectures</b></p> <p><b>2 Lectures</b></p> <p><b>2 Lectures</b></p> <p><b>8 Lectures</b></p>

<b>Unit</b>	<b>Title</b>	<b>No. of Lectures</b>
<b>III</b>	<b>Chemotherapy</b>	<b>15 Lectures (1.5 Credits)</b>
<b>3.1</b>	Basics – a. History & development of chemotherapy b. General properties of antimicrobial agents c. Attributes of an ideal antimicrobial agent	<b>1 Lectures</b>
<b>3.2</b>	Drug Resistance; Origin, Mechanisms & Transmission	<b>3 Lectures</b>
<b>3.3</b>	Selection & Testing : (include E-test & Checker Board Assay)	<b>2 Lectures</b>
<b>3.4</b>	Principal Groups of Antibacterial Agents & Mechanism of Action (Tabulation & Mechanism of action)- a. Cell wall inhibitors, b. Inhibitors of protein synthesis c. Inhibitors of Nucleic Acid synthesis, d. Cell membrane disruptors, e. Antimetabolites	<b>6 Lectures</b>
<b>3.5</b>	Quality Assurance in Diagnostics- Concepts of Quality Assurance in Diagnostics	<b>3 Lectures</b>
<b>IV</b>	<b>Immune System in Health and Diseases</b>	<b>15 Lectures (1.5 Credits)</b>
<b>4.1</b>	Antigen-Antibody Reactions  Precipitation, agglutination, passive agglutination, agglutination inhibition, Complement Fixation, Radioimmunoassay (RIA), Enzyme immunoassays (EIA), Immunofluorescence, western blot technique	<b>7 Lectures</b>
<b>4.2</b>	Vaccines	<b>8 Lectures</b>
<b>4.2.a.</b>	Active and passive immunization	
<b>4.2.b.</b>	Types of vaccines - Killed and attenuated vaccines, Whole organism vaccines, Purified macromolecules as vaccines, recombinant vector vaccines, DNA vaccines,	

<b>4.2.c.</b>	Use of adjuvants in vaccine	
<b>4.2.d.</b>	New vaccine strategies	
<b>4.2.e</b>	Ideal vaccine	
<b>4.2.f.</b>	Route of vaccine administration, Vaccination schedule, Failures in vaccination.	

Course Code	Title	Lectures
BCMB-2	MICROBIAL BIOCHEMISTRY AND BIOPROCESS TECHNOLOGY	06 credits (60 LECTURES)
<b><u>UNIT I</u></b> <b><u>BIOENERGETICS</u></b>  <b>1.1 Bioenergetics (15 lectures)</b> <ol style="list-style-type: none"> <li>a. Electron transport chain: components, complexes and functions of Mitochondrial ETC , Prokaryotic ETC [Organotroph – <i>E. coli</i> - aerobic and anaerobic( only schematic), Lithotroph – <i>Nitrosomonas</i> (Only schematic)]</li> <li>b. Oxidative phosphorylation by Chemiosmotic coupling hypothesis</li> <li>c. Structure of bacterial ATP synthase &amp; Mitochondrial ATP synthase, Mechanism by Rotational catalysis</li> <li>d. Other modes of generation of electrochemical energy- Oxalate formate exchange, Decarboxylases dependent ion transport (for <i>K. pneumoniae</i>), End product efflux, ATP hydrolysis (enlist the mechanisms without detailing)</li> <li>e. Calculation of energetics of ETC / Thermodynamics of ETC (Physiological function of ETC)</li> <li>f. Bacteriorhodopsin: Photo cycle &amp; significance</li> </ol>		<b><u>15 Lectures</u></b> <b>(1.5 Credits)</b>  <b>15 Lectures</b>
<b><u>UNIT II</u></b>  <b>METABOLIC REGULATION</b>		<b><u>15 Lectures</u></b> <b>(1.5 Credits)</b>
<b>2.1</b> Allosteric proteins – Role as enzymes (no kinetic study) and regulatory proteins (eg. Lac repressor, Ara repressor, CAP protein) <b>2.2</b> Regulation of gene expression- Introduction to operon model and positive and negative regulation of operons <ol style="list-style-type: none"> <li>a. By DNA binding proteins eg. Lac operon, Ara operon, Catabolite repression</li> <li>b. By Multiple Sigma Factors</li> </ol> <b>2.3</b> Regulation of enzyme activity (Enzyme inhibition / activation) <ol style="list-style-type: none"> <li>a. Mechanism of End-Product Inhibition End-Product Inhibition in branched pathways- Isofunctional enzymes, concerted feedback Inhibition, sequential feedback inhibition, Cumulative Feedback Inhibition, Combined activation and inhibition</li> <li>b. Covalent modification of regulatory of enzymes – Glutamine synthetase system of <i>E.coli</i></li> </ol>		<b>3 Lectures</b>  <b>5 Lectures</b>  <b>7 Lectures</b>



c. Regulation by proteolytic cleavage	
<p><b><u>UNIT III</u></b>  <b><u>QUALITY ASSURANCE AND BIOINSTRUMENTATION</u></b></p> <p><b>3.1. Quality Assurance</b>  3.1.a. Definitions---GMP, QA, QC  3.1.b. QC of raw materials, in-process items, finished products, packaging materials, labels  3.1.c. Sterility assurance and testing  3.1.d. Microbiological Assays</p> <p><b>3.2. Bioinstrumentation – Principles, working and applications of</b>  3.2.a. Spectroscopic techniques  3.2.b. Spectrophotometry (U.V., Visible, I. R)  3.2.c. Fluorimetry  3.2.d. Flame photometry  3.2.e. Radioisotopes and autoradiography</p>	<p><b><u>15 Lectures</u></b>  <b>(1.5 Credits)</b></p> <p><b>5 Lectures</b></p> <p><b>10 Lectures</b></p>
<p><b><u>UNIT IV BIOTECHNOLOGICAL PRODUCTS AND REGULATORY PRACTICES</u></b></p> <p><b>4.1. Enzyme Technology</b>  4.1.a. Enzyme Immobilization methods  4.1.b. Applications in therapeutic uses, Analytical uses and Industrial uses</p> <p><b>4.2. Commercial Products from Recombinant Microorganisms - Indigo, Bioflavours, Melanin, Biopolymer, Polyhydroxyalkanoate, Rubber, Recombinant proteins of high value</b></p> <p><b>4.3. Intellectual Property Rights</b>  4.3.a. Introduction to IPR – What is intellectual property? Genesis of IPR (WIPO, GATT,TRIPs)  4.3.b. Types of intellectual property –  i. Patents                      ii. Copyright                      iii. Trademark  iv. Trade secret              v. Plant varieties protection act  4.3.c. Patents –  i. Patent system terminologies  ii. Categories of patents  iii. Preparation of patent  ▪ Criteria for patenting  ▪ Patent specification – standard format  ▪ Typical patenting procedure  ▪ Rights of a patentee  iv. Uses of patent system</p>	<p><b><u>15 Lectures</u></b>  <b>(1.5 Credits)</b></p> <p><b>6 Lectures</b></p> <p><b>4 Lectures</b></p> <p><b>5 Lectures</b></p>

## **Text Books and References**

### **BCMB-1: Unit I and II : TEXT BOOKS**

1. Peter J. Russell (2006), "Genetics-A molecular approach", 2<sup>nd</sup> ed.
2. Benjamin A. Pierce (2008), "Genetics a conceptual approach", 3<sup>rd</sup> ed., W. H. Freeman and company.
3. R. H. Tamarin, (2004), "Principles of genetics", Tata McGraw Hill.
4. D.,Nelson and M.Cox, (2005), "Lehninger's Principles of biochemistry", 4<sup>th</sup> ed., Macmillan worth Publishers.
5. M.Madigan, J.Martinko, J.Parkar, (2009), "Brock Biology of microorganisms", 12<sup>th</sup> ed., Pearson Education International.
6. Fairbanks and Anderson, (1999), "Genetics", Wadsworth Publishing Company.
7. Prescott, Harley and Klein, "Microbiology",. 7th edition Mc Graw Hill international edition.
8. Robert Weaver, "Molecular biology", , 3rd edn. Mc Graw Hill international edition.
9. Nancy Trun and Janine Trempy, (2004), "Fundamental bacterial genetics", Blackwell Publishing

### **Reference books:**

1. Benjamin Lewin, "Genes IX", , Jones and Bartlett publishers.
2. JD Watson, "Molecular biology of the gene", , 5<sup>th</sup> edn.
3. Snustad, Simmons, "Principles of genetics", 3<sup>rd</sup> edn. John Wiley & sons, Inc.

### **BCMB-1: Unit III and IV :TEXT BOOKS**

1. Ananthanarayan and Paniker, (2009), "Textbook of Microbiology", 8th Edition.Universal Press
2. Cedric Mims et al, " Medical Microbiology", 3rd Edition Mosby
3. Prescott, Harley, Klein, "Microbiology",. 6<sup>th</sup>/7<sup>th</sup> Edition McGraw Hill
4. Konemann, "Diagnostic Microbiology", 5th and 6th Edition. Lippincott
5. Teri Shors Jones "Understanding Viruses" Bartlett Publisher
6. Richard A. Goldsby, Janis Kuby, "Immunology", , 6th and 7th Edition.  
W. H.Freeman and company.

7. Fahim Halim Khan, "The elements of Immunology",. Pearson Education.
8. Pathak, S., Palan U, "Immunology Essential and Fundamental" ,2nd Edition.  
Capital Publishing company.(3<sup>rd</sup> edition Ref.)
- 9.Ian R. Tizard, "Immunology, An Introduction", 4th - Edition, Saunders college publishing

### **BCMB-2 Unit I and II : TEXT BOOKS**

1. Stanier.R.Y., Ingrahm,J.L., Wheelis, M.L., Painter, R.R.,(1987) General Microbiology, 5<sup>th</sup> edition, The Macmillan press Ltd
2. Conn , Stmpf, P. K., Bruening, G. R. H.(1987) Outlines of Biochemistry, 5<sup>th</sup> edition, John Wiley & sons
3. Gottschalk,G., (1985), Bacterial Metabolism, 2<sup>nd</sup> edition, Springer Verlag
4. White, D., (1995), The Physiology and Biochemistry of Prokaryotes, 3<sup>rd</sup> edition, Oxford University Press
5. Nelson, D, Cox, M,(2005), Lehninger Principles of biochemistry,4<sup>th</sup> edition, W. H. Freeman and Company

### **Reference books:**

1. Voet, D & Voet, J. G., (2004), Biochemistry, 3<sup>rd</sup> edition, John Wiley& Sons Inc
2. Zubey, G. L (1996), Biochemistry, 4<sup>th</sup> edition, Wm. C. Brown publishers
3. Zubey, G. L (1996), Principles of Biochemistry, Wm. C. Brown publishers

### **BCMB-2 : Unit III and IV: TEXT BOOKS**

1. Casida L. E., "Industrial Microbiology" 2009 Reprint, New Age International (P) Ltd, Publishers, New Delhi
2. Stanbury P. F., Whitaker A. & HaII--S. J., 1997, "Principles of Fermentation Technology", 2nd Edition, Aditya Books Pvt. Ltd, New Delhi.
3. Crueger W. and Crueger A. 2000 "Biotechnology -"A Textbook of Industrial Microbiology", 2nd Edition, Panima Publishing Corporation, New Delhi.
4. Prescott and Dunn's "Industrial Microbiology".1982 4th Edition, McMillan Publishers
5. Ratledge & B. Kristinsen 2nd edn 2006. "Basic Biotechnology". Cambridge University Press.

### **Reference Books**

1. Peppler, H. J. and Perlman, D. (1979), "Microbial Technology". Vol 1 & 2, Academic Press
2. Agrawal A. K. and P. Parihar 2005. "Industrial Microbiology"- Fundamentals and Application AGRIBIOS (India)
3. H. A. Modi, 2009. "Fermentation Technology" Vols 1 & 2, Pointer Publications, India
4. Okafor Nkuda 2007 "Modern Industrial Microbiology and Biotechnology", Science Publications Enfield, NH, USA.

