

**“Dissemination of Education for Knowledge, Science and Culture”**  
**-Shikshanmaharshi Dr. Bapuji Salunkhe**

Shri Swami Vivekanand Shikshan Sanstha's  
**VIVEKANAND COLLEGE KOLHAPUR**  
**(AUTONOMOUS)**



**SYLLABUS**  
**FOR**  
**M. Sc. Part-I**  
**MICROBIOLOGY**  
**CBCS PATTERN**  
**2022-23**



**VIVEKANAND COLLEGE, KOLHAPUR  
(AUTONOMOUS)**

**PG DEPARTMENT OF MICROBIOLOGY  
Syllabus for the Master of Science in Microbiology**

**M. Sc. I (Semester I & II)  
Academic Year: 2022 – 2023**

- 1. Title:** M. Sc. Microbiology, Vivekanand College, Kolhapur (Autonomous)
- 2. Faculty:** Faculty of Science and Technology.
- 3. Year of Implementation:** For M. Sc. I (Semester I and Semester II): From September 2022 and for M. Sc. II (Semester III and Semester IV): From July 2023.
- 4. Programme Outcomes (POs):** After completing the M. Sc. Programme, the students will be able to:
  - PO1:** Demonstrate and apply the fundamental knowledge of the basic principles of sciences in various fields.
  - PO2:** Create awareness and a sense of responsibility towards the environment and society to solve the issues related to environmental pollution.
  - PO3:** Apply their professional, social, and personal knowledge.
  - PO3:** Competent to pursue research or pursue a career in the subject.
  - PO4:** Apply knowledge to build up small-scale industries for developing endogenous products.
  - PO5:** Communicate scientific information in a clear and concise manner both orally and in writing.
  - PO6:** Inculcate logical thinking to address a problem and become result oriented with a positive attitude.



## Teaching and Evaluation Scheme

### PG Department Of Microbiology

M. Sc. I (Semester I & II) From Academic Year: 2022 – 2023

Sr. No.	Paper no.	Course Name	Course code	Course Max Marks	Course Pass marks	Course Max Marks	Course Pass marks	Total Max Marks	Total Pass marks	CREDIT
		CGPA		CIE	CIE	CA	CA			
<b>SEMESTER I</b>										
1	I	Taxonomy and Microbial Diversity	CC- 2400	20	8	80	32	100	40	4
2	II	Virology	CC- 2401	20	8	80	32	100	40	4
3	III	Genetics and Molecular Biology	CC- 2402	20	8	80	32	100	40	4
4	IV	Immunology	CC- 2403	20	8	80	32	100	40	4
5	PRACTICAL COURSE-I		CC- 2404					100	40	4
6	PRACTICAL COURSE-II		CC- 2405					100	40	4
								600		24
<b>SEMESTER II</b>										
7	V	Techniques in Microbiology	CC-2406	20	8	80	32	100	40	4
8	VI	Microbial Physiology, Biochemistry and Metabolism	CC-2407	20	8	80	32	100	40	4
9	VII	Medical Microbiology	CC-2408	20	8	80	32	100	40	4
10	VIII	Microbial Ecology	CC-2409	20	8	80	32	100	40	4
11	PRACTICAL COURSE-III		CC-2410					100	40	4
12	PRACTICAL COURSE-IV		CC-2411					100	40	4
								600		24
<b>Total semester I and II</b>								1200		48



### **Programme Specific Outcomes**

- 1) To acquaint the students with the basic as well as advanced concepts in Microbiology.
- 2) To make aware the students about the importance of the subject in daily life.
- 3) To improve the laboratory skills of the students.
- 4) To prepare students for further studies helping in their bright career in the subject
- 5) To make students knowledgeable with industrial processes
- 6) To encourage the students to think the application of the subject studies for progression of mankind.



## SEMESTER – I

Paper I CC - 2401	<b>Taxonomy and Microbial Diversity</b>  Theory : 60 Hours (Credits - 4)	No. of Hours per unit/ credit
<p><b>Expected course outcome -</b></p> <p>Upon successful completion of course, students are expected to be able to –</p> <ul style="list-style-type: none"> <li>▪ Understand the diversity of microorganisms</li> <li>▪ Acknowledge the concept of classification of microorganisms</li> <li>▪ Understand various characteristics of different types of microorganisms</li> <li>▪ Understand how to classify newly discovered organism</li> </ul>		
<b>Unit I</b>	<ol style="list-style-type: none"> <li>1. General characteristics and outline classification of Archaea</li> <li>2. General characteristics of Methanogenic, Extremely Halophilic and Extremely thermophilic Archaeobacteria</li> <li>3. Extremophiles: general characteristics of acidophilic, alkaliphilic, barophilic microorganisms</li> <li>4. General characteristics and outline classification of Actinomycetes</li> </ol>	<b>15/1</b>
<b>Unit II</b>	<ol style="list-style-type: none"> <li>1. Fungi: General characteristics and outline classification of fungi, Morphology of some common fungi - <i>Mucor</i>, <i>Rhizopus</i>, <i>Aspergillus</i>, <i>Penicillium</i> and <i>Fusarium</i></li> <li>2. Yeasts: General characteristics and outline classification of yeasts</li> <li>3. General characteristics of Lichens and Mycorrhiza</li> </ol>	<b>15/1</b>
<b>Unit III</b>	<ol style="list-style-type: none"> <li>1. Anoxygenic photosynthetic bacteria: general characteristics of purple bacteria and green bacteria</li> <li>2. Oxygenic photosynthetic bacteria: General characteristics of Cyanobacteria – external and internal features, physiology and ecology</li> <li>3. Magnetotactic bacteria- General characteristics, Magnetosomes, Enrichment and isolation of Magnetotactic bacteria.</li> </ol>	<b>15/1</b>
<b>Unit IV</b>	<ol style="list-style-type: none"> <li>1. Bergey's Manual System of bacterial classification Brief history of the Bergey's Manual Prokaryotic Domains</li> <li>2. Classification of Prokaryotic organisms- Concept of bacterial speciation, Bacterial nomenclature</li> </ol>	<b>15/1</b>



	<p>3. Modern trends in Prokaryote taxonomy:  Polyphasic taxonomy- Types of information used, polyphasic strategy, polyphasic taxonomy in practice  Phylogenetic basis- Reconstruction and interpretation of phylogenetic trees, limitations, presentation of trees, 16 S rRNA sequence analysis</p>	
	<p><b>REFERENCE BOOKS</b></p> <ol style="list-style-type: none"> <li>1. Introductory Mycology by C. J. Alexopoulos (7th ed) Wiley Eastern Pvt. Ltd., New Delhi.</li> <li>2. Bergey's Manual of Systemic Bacteriology (2nd ed) Springer, USA.</li> <li>3. Basic Bacteriology (3rd ed) by C. Lamanna and F. Mallette The William and Wilkins Company. Calcutta.</li> <li>4. Fundamental Principles of Bacteriology (3rd ed) by A. J. Salle TMH Publishing Company, New Delhi.</li> <li>5. The Yeasts by A. H. Rose</li> <li>6. General Microbiology (5th ed) by R. Y. Stanier and others</li> <li>7. The Prokaryotes: A handbook on the Biology of Bacteria by Martin Dworkin (Editor-in- Chief) and others Springer</li> <li>8. Developmental Microbiology by J. F. Peberdy Blackie &amp; Sons, Glasgow</li> </ol>	
<p><b>Paper II</b>  <b>CC - 2401</b></p>	<p style="text-align: center;"><b>VIROLOGY</b>  Theory : 60 Hours (Credits -4)</p>	<p><b>No. of Hours per unit/ credit</b></p>
	<p><b>Expected course outcome -</b>  <b>The course helps to</b></p> <ul style="list-style-type: none"> <li>▪ Know life cycles of plant, animal and bacterial viruses</li> <li>▪ Acknowledge plant virus transmission, effects of viruses on plant growth, and different plant diseases</li> <li>▪ Understand therapy and prophylaxis of viral diseases.</li> <li>▪ Learn the methods of destruction of viruses</li> </ul>	
<p><b>Unit I</b></p>	<ol style="list-style-type: none"> <li>1. Single burst and premature lysis experiment for phage host interaction</li> <li>2. Productive cycle of T-odd phages</li> <li>3. Productive cycle of lambda phage</li> <li>4. Interaction of <i>Bacillus</i> phages with their hosts.</li> <li>5. Properties of lambda lysogeny</li> </ol>	<p><b>15/1</b></p>



	6. Brief details of lysogenic interactions of P2, P22, P1 and Mu1 phages.	
<b>Unit II</b>	<p>1. Transmission of plant viruses:  Vector transmission- insect, nematode and fungal vectors  Non vector transmission- Seed transmission, graft transmission, mechanical transmission</p> <p>2. Effect of viruses on plants- roots, stem, leaves, flowers and fruits</p> <p>3. Gene expression and replication strategies of-  Potyvirus  TMV  Lettuce necrosis yellow virus</p>	<b>15/1</b>
<b>Unit III</b>	<p>1. Productive cycle of animal viruses having DNA  Herpes viruses  Parvo viruses</p> <p>2. Productive cycle of animal viruses having double stranded RNA- Reo virus</p> <p>3. Productive cycle of animal viruses having single stranded RNA  Rhabdo  Picorna  Retro  Influenza</p>	<b>15/1</b>
<b>Unit IV</b>	<p>1. Slow viruses – Discovery, General features and importance</p> <p>2. DI particles – general features and interactions</p> <p>3. Inhibition and inactivation of bacteriophages, animal viruses and plant viruses- photodynamic inhibition, inactivation by heat and radiations, inactivation by chemicals</p> <p>4. Antiviral chemotherapy- general approach, principles involved (inhibition of viral entry, inhibition of viral nucleic acid function, inhibition of viral protein function), chemicals of therapeutic use</p>	<b>15/1</b>
	<p><b>REFERENCE BOOKS</b></p> <p>1. General Virology- by S. Luria</p> <p>2. Bacterial and Bacteriophage genetics- by Edward A. Birge</p> <p>3. Principles of Bacteriology, Virology and Immunology 8th ed. Vol. IV by Topley and Wilson</p>	



	<p>4. Introduction to Plant Virology – by Bos I.</p> <p>5. Field's Virology Vol I and II – by Lipincott</p> <p>6. Biotechnology: application and research– by Paul N. Cheremisinoff, Robert P. Ouellette</p> <p>7. Molecular Biology and Biotechnology – by Walker and Gingold</p> <p>8. Medical Microbiology 2nd ed.- by Mims, Play four and Roitt</p> <p>9. Brock's Biology of Microorganisms by Madigan</p> <p>10. Advances in General Microbiology Vol. I- by Shrivastava</p> <p>11. Plant Viruses as Molecular Pathogens by Jawed A Khan and Jeanne Dijkstra</p>	
<p>Paper III CC - 2402</p>	<p style="text-align: center;"><b>GENETICS AND MOLECULAR BIOLOGY</b></p> <p style="text-align: center;">Theory : 60 Hours (Credits -4)</p>	<p>No. of Hours per unit/ credit</p>
	<p><b>Expected course outcome -</b></p> <p>Upon successful completion of course, students are expected to be able to –</p> <ul style="list-style-type: none"> <li>▪ Know the mechanism of DNA replication in prokaryotes and eukaryotes</li> <li>▪ Understand the concept of unique and repetitive DNA sequences</li> <li>▪ Explain the modes of cell division with respect to mitosis and meiosis</li> <li>▪ Acknowledge basic and advanced techniques used in molecular genetics</li> </ul>	
<p><b>Unit I</b></p>	<p>1. Origin of life- aspects of prebiotic environment, evolution of the pre-cell.</p> <p>2. Organic evolution: concepts and theories, mechanisms of speciation, genetic basis of evolution - Hardy-Weinberg genetic equilibrium, evolutionary clock.</p> <p>3. Molecular basis- genetic polymorphism and selection, coincidental and concerted molecular basis, gene duplication, sequence divergence, recombination and crossover fixation, pseudo-genes as dead ends of evolution</p> <p>4. Origin and evolution of economically important microbes, plants and animals.</p> <p>5. Evidences for nucleic acids as genetic material.</p> <p>6. Organization of eukaryotic genetic material: Operon, Unique and repetitive DNA, Interrupted genes, gene families, structure of chromatin and</p>	<p><b>15/1</b></p>





	chromosomes, heterochromatin and euchromatin. Polytene and Lampbrush chromosomes.	
<b>Unit II</b>	<ol style="list-style-type: none"> <li>1. Principles of Mendelian inheritance: linkage and gene mapping - Tetrad analysis, split and overlapping genes.</li> <li>3. Law of DNA constancy and redundancy, C-value paradox, Cot curves and DNA re-association constant, dosage compensation, genetic load.</li> <li>4. Molecular basis of mitosis and meiosis</li> <li>5. Replication of DNA and duplication of chromosomes – modes and molecular mechanisms of DNA replication in prokaryotes (bacteria) and eukaryotes (nuclear and mitochondrial). Co-transcriptional and post-transcriptional processing of RNA, structure and stability of mRNA</li> </ol>	<b>15/1</b>
<b>Unit III</b>	<ol style="list-style-type: none"> <li>1. Translation in eukaryotes – machinery, initiation, elongation, termination and release, posttranslational processing.</li> <li>2. Localization of proteins in cell - mechanisms of transport to nucleus, mitochondria, chloroplasts and outside the cell</li> <li>3. Molecular mechanism of homologous recombination in bacteria and other organisms– RecBCD and Ruv systems, Holliday junction, interallelic, specialized and site specific recombination; Gene targeting.</li> <li>4. Restriction and modification of DNA – enzymes, molecular mechanisms and significance.</li> </ol>	<b>15/1</b>
<b>Unit IV</b>	<ol style="list-style-type: none"> <li>1. Teratogenesis- chromosome aberrations, genetic disorders; Genetic counseling.</li> <li>2. Cancer and oncogenesis: Transforming viruses, environmental factors causing cancer -carcinogens Molecular mechanism and sequence of changes leading to oncogenesis - mutations, activation of proto-oncogenes, loss of function of tumour suppressor (anti-cancer) genes, role of apoptosis and telomere shortening in cancer.</li> <li>3. Techniques in molecular genetics: Basic techniques - PCR, LCR, Nick translation, Blotting techniques – Southern, Northern and Southwestern blotting, colony hybridization</li> </ol>	<b>15/1</b>



	<p>Applications - Chromosome walking, DNA foot printing and 16s rRNA sequence analysis</p> <p>Transfection – Protoplast fusion, electroporation</p>	
	<p><b>REFERENCE BOOKS</b></p> <ol style="list-style-type: none"> <li>1. Molecular Biology of the Cell by Alberts and others, Garland Publishing, NY.</li> <li>2. Concept of Evolution by P. S. Verma and V. K. Agarwal, S. Chand and Co., New Delhi</li> <li>3. Organic Evolution by N. Arumugam</li> <li>4. Organic Evolution by R. S. Lulla, Seema Publications</li> <li>5. Genetics by Strickberger</li> <li>6. Microbial Genetics by D. Freifelder, J. Wiley and Sons</li> <li>7. Genes – VI, VII, VIII and IX by B. Lewin, Jones and Bartlett Publishers</li> <li>8. Molecular Biology of the Gene by J. D. Watson and others, Benjamin Cummings Publishing Co.</li> <li>9. Genetics by S. Mitra, Macmillan India</li> <li>10. Genetic Engineering by S. Mitra, Macmillan India</li> <li>11. Molecular Biology and Biotechnology by J. M. Walker and R. Rapley, Panima Publishing Corp. New Delhi</li> <li>12. Molecular Biology by P. C. Turner and others, Bioscientific Publishers</li> <li>13. Principles of Genetics and Genetic Engineering by E. John Jothi Prakash, JPR Publications</li> <li>14. Principles and Techniques of Practical Biochemistry by K. Wilson and J. Walker, Cambridge University Press</li> <li>15. Molecular Cloning – A Laboratory Manual, Vol. 1, 2, 3 by J. Sambrook, E. F. Fritsch and T. Maniatis</li> <li>16. An Introduction to Genetic Analysis Freeman 1993</li> <li>17. Molecular Genetics of Bacteria by L. Snyder and W. Champness, ASM Press, Washington</li> </ol>	
<p>Paper IV CC - 2403</p>	<p><b>IMMUNOLOGY</b></p> <p>Theory : 60 Hours (Credits -4)</p>	<p>No. of Hours per unit/</p>



		credit
	<p><b>On completion of course , student learn about –</b></p> <ul style="list-style-type: none"> <li>▪ <b>Functioning of immune system</b></li> <li>▪ <b>Regulatory mechanisms of immune system</b></li> <li>▪ <b>Cancer immunology and treatment and prevention of cancer</b></li> <li>▪ <b>Various serodiagnostic techniques of diseases.</b></li> </ul>	
<b>Unit I</b>	<ol style="list-style-type: none"> <li>1. MHC complex: structure, function, MHC polymorphism, assembly and presentation of peptide MHC complex.</li> <li>2. Signal transduction: Ras dependant and Jak/Stat pathway, signal transduction by IL-1, IL- 2 and T-cell anti gene receptors.</li> <li>3. T-cell sensitization: TCR signaling by CD 45 and CD 28, Interaction of T-cells with APCs.</li> </ol>	<b>15/1</b>
<b>Unit II</b>	<ol style="list-style-type: none"> <li>1. Complement System: Regulation of complement pathways, biological consequences of activation, complement polymorphism</li> <li>2. Genetics of antibody synthesis: Types of genes, location and positions of genes, genes for constant region, genes for variable region of immunoglobulin</li> <li>3. Antibody diversity: Introduction, Mechanisms.</li> <li>4. Immunomodulation, potentiation, tolerance and suppression.</li> <li>5. Vaccines DNA, rDNA vaccines, Edible vaccines, Carrier, Synthetic peptide, subunit vaccines, anti-idiotypic</li> </ol>	<b>15/1</b>
<b>Unit III</b>	<ol style="list-style-type: none"> <li>1. Transplantation immunology: Immunological basis of graft rejection, clinical manifestation, immunosuppressive therapy, Kidney transplantation – ABO testing, pathology of graft rejection</li> <li>2. Tumor immunology: Development of tumors, Antigen of tumor cells, immunological mechanisms against tumor cells, escaping of tumor cells from immune response, immune surveillance, immunocompromise and cancer, congenital immunodeficiency and neoplasia, cancer in organ transplant recipients and auto immune disorders, HIV and cancer, Immunotherapy and immunoprophylaxis of human cancer.</li> </ol>	<b>15/1</b>
<b>Unit IV</b>	<ol style="list-style-type: none"> <li>1. Serodiagnosis of diseases: Approaches for serodiagnosis, detection of antigen or antibody, diagnostic titer, ASO, Cold hemagglutination test, Weil-Felix test, Tuberculin test, Paul- Bunnel test.</li> </ol>	<b>15/1</b>



	<p>2. Immunochemical techniques and their applications:  Immunochemical technique, ELISA, FAT, Western blot technique, Immunoelectrophoresis (IEP), Immunodiffusion, Fluorescence Activated Cell Sorters.</p> <p>2. PCR based diagnostic tests</p>	
	<p><b>REFERENCE BOOKS</b></p> <ol style="list-style-type: none"> <li>1. Basic and Clinical Immunology by Stites Daniel P., Stobo John D., Frudenberg H.H., Wells J.V.</li> <li>2. Biotechnology Application and Research by P. N. Cheremisinoff and R. P. Ouellette</li> <li>3. Essential Immunology by Roitt Ivan M.</li> <li>4. Fundamentals of Immunology 2nd ed. by Myrick Quentin N. and Weiser Russell S.</li> <li>5. Immunobiotechnology by Mahadev Sharma and Nirmal Tripathi</li> <li>6. Immunology by I Kannan</li> <li>7. Immunology 3rd ed. by Roitt I. M., Brostoff J., Male D.K.</li> <li>8. Immunology 5th ed. by R. A. Goldsby, T. J. Kindt, B. A. Osborne, J. Kuby</li> <li>9. Immunology II by Bellanti Joseph A.</li> <li>10. Medical Immunology 9th ed. by Daniel P. Stites, Abba I Terr, Tristram G. Parslow.</li> <li>11. Medical Microbiology by Cruickshank Robert, Duguid J. P., Marmion B. P., Swain R.H.</li> <li>12. Medical Microbiology by Irving William and others</li> <li>13. Medical Microbiology 13th Edition by Jawetz Ernest, Melnick Joseph L, Adelberg E.A.</li> <li>14. Medical Microbiology 6th Edition by Gupte Satish, Jaypee Brothers,</li> <li>15. Medical Microbiology S Rajan MJP Publishers.</li> <li>16. Principles and techniques in Practical Biochemistry by K. Wilson and J. M. Walker</li> <li>17. Text book of Microbiology by Vasanthakumari R.</li> <li>18. The text book of Microbiology by Dubey R. C., Maheshwari D.K.</li> </ol>	
	<b>PRACTICAL COURSE</b>	
<b>CCPR-2404</b>	Practical Course I	



Unit I	<ol style="list-style-type: none"> <li>1. Isolation and morphological study of <i>Aspergillus</i>, <i>Penicillium</i>, <i>Rhizopus</i> and <i>Mucor</i> species by slide culture method</li> <li>2. Isolation and morphological studies of yeast from sugar and starchy materials</li> <li>3. Induction and observation of Ascospores of <i>Saccharomyce scerevisiae</i></li> <li>4. Isolation and morphological studies of Actinomycetes by coverslip technique</li> <li>5. Enrichment and Isolation of Anoxygenic phototrophic bacteria</li> <li>6. Isolation and Characterization of thermophilic bacteria</li> <li>7. Isolation and Characterization of Acidophilic bacteria</li> <li>8. Isolation and Characterization of Halophilic and halotolerant bacteria.</li> </ol>	60/2
Unit II	<ol style="list-style-type: none"> <li>1. Phage typing of <i>E. coli</i></li> <li>2. Titration of <i>E. coli</i> phages</li> <li>3. Preparation of high titre stock of <i>E. coli</i> phages</li> <li>4. Study of one step growth of T-4phage</li> <li>5. Isolation of plaque morphology mutants of phages by using UV radiations</li> <li>6. Isolation of plaque morphology mutants of phages by using chemical mutagen</li> <li>7. Demonstration of egg inoculation techniques</li> </ol>	60/2
	<p><b>REFERENCE BOOKS</b></p> <ol style="list-style-type: none"> <li>1. Practical Microbiology by R. C. Dubey and D. K. Maheshwari. S. Chand &amp;Co.</li> <li>2. Environmental Science and Biotechnology: Theory and Techniques by A. G. Murugesan and C. Rajakumari. MJP Publishers</li> <li>3. Experimental Microbiology by R. J. Patel. Aditya Publishers, Ahmedabad</li> <li>4. Analysis of Plants, Irrigation water and Soils by R. B. Somawanshi and others. Mahatma Phule Agricultural University, Rahuri</li> <li>5. Identification Methods for Microbiologists by B. M. Gibbs and F. A. Skinner. Academic Press</li> <li>6. Laboratory Microbiology by L. Jack Bradshaw. W. B. Saunders &amp;Co.</li> <li>7. Benson's Microbiological Applications Laboratory Manual in General Microbiology by Alfred E. Brown</li> <li>8. Methods in Microbiology (Vol. 5B and Vol. 3A) by Norris and Ribbons. Academic Press</li> </ol>	



	<p>9. Bergey's Manual of Systematic Bacteriology</p> <p>10. Microbiological Methods by Michael Collins</p> <p>11. Handbook of Microbiological Media by R. M. Atlas. CRC Publications</p> <p>12. Laboratory Exercises in Microbiology by Robert A. Pollock and others</p> <p>13. Laboratory Techniques in Microbiology and Biotechnology by R. P. Tiwari, G. S. Hoondal and R. Tewari, Abhishek Publications, Chandigarh</p> <p>14. Handbook of Techniques in Microbiology by A. S. Karwa, M. K. Rai and H. B. Singh. Scientific Publishers, Jodhpur</p> <p>15. Laboratory Exercises in Microbiology by J. P. Harley and L. M. Prescott 5thEd.</p>	
<b>CCPR-2405</b>	<b>Practical Course II</b>	
<b>Unit I</b>	<p>1. Isolation of RNA from yeasts.</p> <p>2. Isolation of Plasmid DNA from bacteria</p> <p>3. Thermal denaturation of DNA</p> <p>4. Gene transfer in <i>E. coli</i> by –conjugation</p> <p>5. Demonstration of protoplast fusion in bacteria</p> <p>6. Estimation of mutation rate in <i>E.coli</i></p> <p>7. Synthesis of inducible enzyme <math>\beta</math>-galactosidase in <i>E. coli</i></p> <p>8. PCR (demonstration)</p>	<b>60/2</b>
<b>Unit II</b>	<p>1. Ouchterlony's double diffusion test</p> <p>2. Radial immunodiffusion test</p> <p>3. Immunoelectrophoresis test</p> <p>4. ASO test</p> <p>5. RA test</p> <p>6. Weil-Felix test</p> <p>7. Isolation of immunoglobulins from whole blood</p>	<b>60/2</b>

	<b>SEMESTER II</b>	
<b>Paper V</b> <b>CC - 2406</b>	<b>TECHNIQUES IN MICROBIOLOGY</b> Theory : 60 Hours (Credits -4)	<b>No. of Hours per unit/ credit</b>



**Expected course outcome -**

**Upon successful completion of course, students are expected to be able to –**

- Understand various traditional and advanced techniques used in life science laboratory
- Understand the working and mechanism of the techniques used in the life science research
- Know regarding the ethics that have to follow in research studies
- Acknowledge different applications of the techniques in the research work

<b>Unit I</b>	<ol style="list-style-type: none"><li>1. Enrichment culture techniques – principles and selective factors employed, enrichment systems – closed and open, single cell isolation methods</li><li>2. Principles and methods of preservation of bacteria, viruses, yeasts and molds</li><li>3. Isolation and cultivation of anaerobes – principles, reducing agents, indicators, anaerobic jar methods and anaerobic glove box, Hungate's roll tube technique and its serum bottle modification.</li><li>4. Isolation of human and animal pathogenic fungi</li><li>5. Microscopic techniques– Electron microscopy – principles and working of transmission and scanning microscopes.</li><li>5.1 Dark field, phase contrast, polarisation, differential interference contrast (DIC), fluorescence, confocal scanning, scanning tunnelling, atomic force microscopy.</li></ol>	<b>15/1</b>
<b>Unit II</b>	<ol style="list-style-type: none"><li>1. Good laboratory practices: Accuracy in preparation of solutions, media, etc. Qualifications of equipment – design (DQ), installation (IQ), operational (OQ) and performance (PQ) Validation and calibration Documentation- Concepts, necessity and types</li><li>2. Safety in the laboratory: Common hazards in the laboratory– Electrical equipment Chemicals – corrosive, irritant, toxic, flammable, explosive Ionising radiations Infectious materials Gas and fire Safety measures– In the use of equipments and gas facility Personal protection Waste disposal</li></ol>	<b>15/1</b>



	<p>First aid</p> <p>3. Cell disruption methods – principles and methods of disruption of microbial, plant and animal cells and separation of cellular components</p>	
<b>Unit III</b>	<p>1. Chromatography – general principles and working of Column chromatography – gel, ion exchange. Gas chromatography HPLC</p> <p>2. Electrophoresis- Polyacrylamide gel electrophoresis (PAGE) - native and gradient gels, DNA Sequencing gels, SDS-PAGE, isoelectric focusing, 2-DPAGE Agarose gel electrophoresis- DNA gel, Pulsed field gel, RNA electrophoresis. Capillary electrophoresis</p> <p>3. Centrifugation – principles of differential and density Gradient centrifugation, sedimentation coefficient determination</p>	<b>15/1</b>
<b>Unit IV</b>	<p>1. Spectroscopy – Principles of IR and Raman spectrophotometry, turbidimetry and nephelometry, fluorimetry, luminometry, circular dichroism and optical rotational dichroism spectrophotometry, ESR, NMR</p> <p>1. Massspectrometry</p> <p>2. X – ray crystallography</p> <p>3. Radioisotopic techniques– Nature of radioactivity and general principles of radioisotopic techniques Methods of detection of radioactivity – gas ionization (GM counter), excitation (scintillation) and exposure of photographic emulsions (autoradiography). Methods of using radioisotopes – radioisotope tracer technique, isotope dilution assay (RIA) and other methods</p> <p>4. Electrochemical techniques – general principles of electrochemical cells and potentiometry, principles and applications of the pH, ion selective and oxygen electrodes</p>	<b>15/1</b>
	<p><b>REFERENCE BOOKS</b></p> <p>1. Methods in Microbiology (series) by Norris and Ribbons, Academic Press, NY.</p>	





	<p>2. Principles and techniques in Practical Biochemistry by K. Wilson and J. M. Walker</p> <p>3. Research Methodology for Biological Sciences by N. Gurumani, MJP Publishers, Chennai</p> <p>4. Bioinstrumentation by L. Veerakumari, MJP Publishers, Chennai</p> <p>5. A manual of Laboratory Techniques by N. Raghuramulu and others, NIN, Hyderabad</p> <p>6. Microbiological aspects of Anaerobic Digestion – Laboratory Manual by D. R. Ranade and R. V. Gadre, MACS, Agharkar Research Institute, Pune</p> <p>7. Isolation Methods for Anaerobes by Shapton, Academic Press.</p> <p>8. Tools in Biochemistry by D. Cooper</p> <p>9. Protein Purification by R. Scopes, Springer Verlag Publications</p> <p>Analytical Biochemistry (Biochemical Techniques) by P. Asokan, Chinna Publications</p>	
Paper VI CC - 2407	<p><b>MICROBIAL PHYSIOLOGY, BIOCHEMISTRY AND METABOLISM</b></p> <p>Theory : 60 Hours (Credits -4)</p>	No. of Hours per unit/ credit
	<p><b>Expected course outcome -</b></p> <p><b>Upon successful completion of course, students are expected to be able to –</b></p> <ul style="list-style-type: none"> <li>▪ Understand various chemical reactions occurring during growth of organisms</li> <li>▪ Know biosynthesis of macromolecules</li> <li>▪ Understand mechanisms of macromolecules degradation</li> <li>▪ Understand basic concepts and some recent developments in biochemistry</li> </ul>	
Unit I	<p>1. Carbohydrate metabolism: Citric acid cycle- steps involved, Amphibolic nature, anaplerotic reactions.</p> <p>2. Oxidation of hydrocarbons: Aliphatic hydrocarbons - alkanes and alkenes- alpha, beta and omega oxidation Aromatic hydrocarbons - beta keto adipate pathway, valerate pathway and gentisate pathway</p> <p>3. Oxidation of fatty acids and phospholipids: beta-oxidation of fatty acids,</p>	15/1



	<p>phospholipases and thioesterases</p> <p>4. Catabolism of amino acids (General reactions)</p> <p>5. Pasteur and Crabtree effect</p> <p>6. Autotrophy - Concept, factors for, types of autotrophs, mechanisms</p>	
<b>Unit II</b>	<p>1. Respiratory metabolism: Mitochondrial ETC- structure of mitochondrion, ETC and its components, Shuttle system across membrane, Atkinson's energy charge. Oxygen toxicity- mechanism of oxygen toxicity, mechanism to overcome the toxicity - catalase, peroxidase and superoxide dismutase</p> <p>2. Photo-phosphorylation in bacteria- Photosynthetic and non-photosynthetic ETC Cyclic and non-cyclic photophosphorylation</p> <p>3. Drug metabolism in the body, mechanisms of detoxification of various substances Fermentation of saccharolytic clostridia and propionic acid bacteria</p>	<b>15/1</b>
<b>Unit III</b>	<p>1. Protein chemistry- Structure of peptide bond, stabilization of conformation, Secondary structure, alpha helix, beta conformation, Ramachandran plot Tertiary structure Quaternary structure</p> <p>2. Biosynthesis of amino acids: a- ketoglutarate family, oxaloacetate family, Pyruvate family</p> <p>3. Lipid metabolism in prokaryotes- Biosynthesis of fatty acids</p> <p>4. Phospholipid biosynthesis – phosphatidylethanolamine and phosphatidylglycerol Regulation of lipid metabolism</p> <p>5. Purine and pyridine biosynthesis- de novo pathway and salvage pathway</p>	<b>15/1</b>
<b>Unit IV</b>	<p>1. Osmosis- Effect of osmotic stress on microorganisms, plasmolysis and plasmoptysis, Microbial response to osmotic stress</p> <p>2. Permeation- Primary active transport, secondary active transport, co-transport Transport of ions across the membrane V-type, F-type and P-type ATPases</p> <p>3. Bio-signaling- Molecular mechanisms, signaling in bacteria- The two-</p>	<b>15/1</b>



	<p>component signaling mechanism in bacterial chemotaxis</p> <p>4. Microbial hormones and quorum sensing in microorganisms</p>	
	<p><b>REFERENCE BOOKS</b></p> <ol style="list-style-type: none"> <li>1. Text book of Biochemistry 4th ed. by West, Todd, Mason and Burgen</li> <li>2. Principles of Biochemistry 5th ed. by White, Handler, Smith</li> <li>3. Lehninger Principles of Biochemistry by Nelson and Cox</li> <li>4. Biochemistry by Zubay</li> <li>5. Elements of Biochemistry by O. P. Agrawal</li> <li>6. Bacterial Metabolism by H. W. Doelle</li> <li>7. Bacterial Metabolism by Gottschalk</li> <li>8. Advances in General Microbiology by Shrivastava</li> <li>9. Biochemistry by Stryer</li> <li>10. Biochemistry of Lipids, Lipoproteins and membranes by D. E. Vance and J. E. Vance Elsevier Science</li> <li>11. Microbial Physiology by A. G. Moat and others Wiley India Edition</li> </ol>	
<p><b>Paper VII</b> <b>CC-2408</b></p>	<p><b>MEDICAL MICROBIOLOGY</b> Theory : 60 Hours (Credits -4)</p>	<p><b>No. of Hours per unit/ credit</b></p>
	<p><b>Expected course outcome -</b> <b>Upon successful completion of course, students are expected to be able to –</b></p> <ul style="list-style-type: none"> <li>▪ Understand various bacterial, fungal, and viral diseases in humans</li> <li>▪ Understand mechanisms of disease development</li> <li>▪ Understand medical applications of microbial metabolites</li> <li>▪ Know immunological disorders.</li> </ul>	
<p><b>Unit I</b></p>	<ol style="list-style-type: none"> <li>1. Virulence: Establishment, spreading, bacterial adhesion to host cells, bacterial invasion of host cells and its mechanisms.</li> <li>2. Attributes of microorganisms that enable them to cause disease: Exotoxins (Diphtheria, Cholera, Clostridial, Staphylococcal) Endotoxins of gram negative bacteria Extracellular enzymes (Coagulase , Lysozyme)</li> <li>3. Pathogen survival mechanisms: Capsulation, sporulation, cyst formation</li> </ol>	<p><b>15/1</b></p>



	<p>Against Environmental factors-</p> <p>Physical (Heat, radiations)</p> <p>Chemical (antibiotics and disinfectants)</p> <p>immune escape mechanisms</p> <p>4. Collection and transport of clinical specimens (clinical samples from throat, Alimentary tract, genito-urinary tract, conjunctiva, ear, blood), preliminary processing of specimens</p>	
<b>Unit II</b>	<p>1. Bacterial Diseases: causative agent - morphological, cultural, biochemical, antigenic characters; lab diagnosis, transmission, prevention and control of diseases caused by <i>Leptospira icterohemorrhagy</i>, <i>Streptococcus mutans</i> <i>Rickettsia burnetti</i>, <i>Mycobacterium tuberculosis</i></p> <p>2. Fungal Diseases: Etiology, clinical features, pathogenesis, laboratory diagnosis, prevention and control of</p> <p>Superficial Mycoses –Pityriasis</p> <p>Subcutaneous Mycoses –Mycetoma</p> <p>Systemic Mycoses –Histoplasmosis</p>	<b>15/1</b>
<b>Unit III</b>	<p>1. Etiology, clinical features, pathogenesis, Laboratory diagnosis, prevention and control of diseases caused by–</p> <p>Herpes virus, Encephalitis virus, Influenza -H1N1</p> <p>2. Diseases caused by Protozoa – Leishmaniasis, Filariasis</p> <p>3. Pathology of AIDS and prevalence of Tuberculosis, Mycoplasma and Cryptococcus infections</p> <p>4. Special microbial metabolites and their applications in health care–</p> <p>Lovastatin, Daunorubicin</p>	<b>15/1</b>
<b>Unit IV</b>	<p>1. B-cell immune deficiency disorders:</p> <p>X-linkedagammaglobinaemia</p> <p>Selective IgA and IgM deficiency</p> <p>2. T-cell immunodeficiency disorders: Congenital thymica plassia</p> <p>3. Combined B-cell and T-cell immunodeficiency disorders:</p> <p>Ataxiatelangiectasia, Graft versus host disease.</p> <p>4. Complement disorders: complement component deficiency</p> <p>5. Rheumatic disease: Systemic lupus erythematosus</p> <p>6. Atopic diseases: Allergic rhinitis and asthma</p> <p>7. Autoimmune diseases: Organ specific and systemic autoimmune diseases,</p>	<b>15/1</b>



	mechanism of induction of autoimmunity, treatment	
	<p><b>REFERENCE BOOKS</b></p> <ol style="list-style-type: none"> <li>1. Basic and clinical Immunology by D. P. Stites, J. D. Stobo, H. H. Frudenber, J. V. Wells</li> <li>2. Medical Microbiology, 13th Edition by E. Jawetz, J. L. Melnick, E. A. Adelberg</li> <li>3. Medical Microbiology, 6th Edition by S. Gupte, Jaypee Brothers Publications</li> <li>4. Medical Microbiology, by W. Irving, T. Boswell and D. Aladeen</li> <li>5. Medical Microbiology, by R. Cruickshank, J. P. Duguid, B. P. Marmion, R. H. A. Swain</li> <li>6. The Textbook of Microbiology, by R. C. Dubey and D. K. Maheshwari</li> <li>7. Text book of Microbiology by R. Vasanthkumari</li> <li>8. Medical Microbiology by S. Rajan MJP Publishers</li> <li>9. Immunology II by J. A. Bellanti</li> <li>10. Medical Immunology 9th ed. by D. P. Stites, I. T. Abba, T. G. Parslow</li> <li>11. Immunology by I Kannan</li> <li>12. Immunobiotechnology by M. Sharma and N. Tripathi</li> <li>13. Biotechnology Application and Research by P. N. Cheremisinoff and R. P. Ouellette</li> <li>14. Immunology 5th ed. by R. A. Goldsby, T. J. Kindt, B. A. Osborne and J. Kuby</li> <li>15. Fundamentals of Immunology 2nd ed. by Q. N. Myrrik and R. S. Weiser</li> <li>16. Essential Immunology by I. M. Roitt</li> <li>17. Immunology 3rd ed. by I. M. Roitt, J. Brostoff and D. K. Male</li> </ol>	
Paper VIII CC-2409	<p style="text-align: center;"><b>MICROBIAL ECOLOGY</b></p> <p style="text-align: center;">Theory : 60 Hours (Credits -4)</p>	No. of Hours per unit/ credit
	<p><b>Expected course outcome -</b></p> <p>Upon successful completion of course, students are expected to be able to –</p> <ul style="list-style-type: none"> <li>▪ Understand concept of microbial ecosystem</li> <li>▪ Understand the effect of environmental factors on the microbial life</li> <li>▪ Know interactions of microbes with other microbes and other living systems like plants and animals.</li> </ul>	



	<p>▪ <b>Acknowledge control of pest with biological way.</b></p>	
<b>Unit I</b>	<ol style="list-style-type: none"> <li>1. Concept and importance of microbial ecology.</li> <li>2. Microbial communities and ecosystems - Development of microbial communities, Experimental Ecosystem models – Batch system, Flow-Through System, Microcosm, Germ free animal.</li> <li>3. Physiological ecology of Microorganisms: abiotic limitations to microbial growth, starvation strategies, environmental determinants - temperature, radiation, pressure, salinity, water activity, pH, redox potential, magnetic force, organic and inorganic compounds</li> </ol>	<b>15/1</b>
<b>Unit II</b>	<ol style="list-style-type: none"> <li>1. Culture dependant and culture independent analyses of microbial communities.</li> <li>2. Quantitative ecology: Sample collection, processing and detection</li> <li>3. Determination of microbial numbers, biomass, measurement of microbial metabolism.</li> </ol>	<b>15/1</b>
<b>Unit III</b>	<ol style="list-style-type: none"> <li>1. Biological interactions –            Microbe – Microbe interactions – Interaction within single microbial population- positive and negative interactions, Interactions between diverse microbial populations- mutualism, commensalism, synergism, ammensalism, parasitism and predation.             Microbe – Plant interactions – Interactions with aerial plant structures.            Microbe – Animal interactions- Microbial contributions to animal nutrition, Commensal and mutualistic intestinal symbionts, Symbiotic light production.</li> </ol>	<b>15/1</b>
<b>Unit IV</b>	<ol style="list-style-type: none"> <li>1. The animal as an environment – The indigenous microbial population of alimentary tract and skin, factors affecting composition of flora, sources of nutrients for organisms in the alimentary tract and on skin, energy metabolism in rumen</li> <li>2. Ecological control of pests and disease causing populations-Modification of populations, reservoirs of pathogens and vector populations. Microbial control of pests, genetic engineering in biological control.</li> </ol>	<b>15/1</b>
	<p><b>REFERENCE BOOKS</b></p> <ol style="list-style-type: none"> <li>1. Microbial Ecology by M. Lynch and others</li> <li>2. Experimental Microbial Ecology by R. C. Burns and others</li> <li>3. Environmental Microbiology by K. Vijaya Ramesh, MJP Publishers</li> <li>4. Microbial Ecology by Larry L. Barton and Diana E. Northup</li> </ol>	



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	Practical Course	
CCPR-2410	Practical Course III	
Unit I	<ol style="list-style-type: none"> <li>1. Enrichment and isolation of chitin degrading bacteria</li> <li>2. Enrichment of <i>Clostridium</i> species using potato, Thioglycollate broth and Candle jar</li> <li>3. Spectroscopy- Calibration of colorimeter/ spectrophotometer (Verification of Beer's law), Determination of absorption maxima, molar extinction coefficient and difference spectra</li> <li>4. Chromatography- Separation of dyes and amino acids on silica gel column Ion exchange chromatography of amino acids /proteins</li> <li>5. Agarose gelelectrophoresis</li> <li>6. Density gradient centrifugation of budding yeast cells</li> <li>7. Preservation of microbial cultures- Slant cultures of aerobic and facultative organisms Stab cultures of microaerophilic organisms Soil culture technique for spore formers</li> </ol>	60/2
Unit II	<ol style="list-style-type: none"> <li>8. Determination of specific growth rate and generation time of <i>E. coli</i></li> <li>9. Determination of protein content of bacteria</li> <li>10. Determination of carbohydrate content of bacteria</li> <li>11. Determination of nucleic acid (DNA, RNA) content of bacteria</li> <li>12. Effect of hypotonic and hypertonic solutions on cells</li> <li>13. Determination of phenol coefficient of 'test disinfectant'</li> </ol>	60/2
	<p><b>REFERENCE BOOKS</b></p> <ol style="list-style-type: none"> <li>1. Laboratory Manual in Biochemistry by J. Jayaraman. New Age International Publishers</li> </ol>	



	<ol style="list-style-type: none"> <li>2. Experimental Microbiology by R. J. Patel. Aditya Publishers, Ahmedabad</li> <li>3. Laboratory Methods in Food Microbiology by Harrigan, Academic Press</li> <li>4. Identification Methods for Microbiologists by B. M. Gibbs and F. A. Skinner. Academic Press</li> <li>5. Laboratory Microbiology by L. Jack Bradshaw. W. B. Saunders &amp; Co.</li> <li>6. Benson's Microbiological Applications Laboratory Manual in General</li> <li>7. Microbiology by Alfred E. Brown</li> <li>8. Methods in Microbiology (Vol. 1, 3A and 5B) by Norris and Ribbons. Academic Press</li> <li>9. Microbiological Methods by Michael Collins</li> <li>10. Handbook of Microbiological Media by R. M. Atlas. CRC Publications</li> <li>11. Laboratory Exercises in Microbiology by Robert A. Pollock and others</li> </ol>	
<b>CCPR-2411</b>	<b>Practical Course IV</b>	
<b>Unit I</b>	<ol style="list-style-type: none"> <li>1. Qualitative and Quantitative study of water microflora</li> <li>2. Study of microflora in Winogradsky column</li> <li>3. Qualitative and quantitative study of air microflora</li> <li>4. Isolation and characterization of microflora from human skin.</li> <li>5. Demonstration of bacterial synergism and antagonism</li> <li>6. Detection of siderophores production by microorganisms</li> <li>7. Isolation and characterization of ruminant bacteria from animal gut.</li> </ol>	<b>60/2</b>
<b>Unit II</b>	<ol style="list-style-type: none"> <li>8. Using Bergey's Manual of Systematic Bacteriology for identification of Bacteria.</li> <li>9. Isolation and characterization of respiratory pathogenic bacteria from throat.</li> <li>10. Determination of susceptibility to dental caries by Snyder test</li> <li>11. Isolation and characterization of etiological agent of dental caries</li> <li>12. Isolation and characterization of enteric pathogens from clinical samples</li> <li>13. Isolation and characterization of Urinary tract infection causing bacteria from urine.</li> <li>14. Antibiotic sensitivity of Urinary tract infection causing bacteria.</li> </ol>	<b>60/2</b>
	<p style="text-align: center;"><b>REFERENCE BOOKS</b></p> <ol style="list-style-type: none"> <li>1. Practical Microbiology by R. C. Dubey and D. K. Maheshwari. S. Chand &amp; Co.</li> </ol>	



	<ol style="list-style-type: none"> <li>2. Environmental Science and Biotechnology: Theory and Techniques by A. G. Murugesan and C. Rajakumari. MJP Publishers</li> <li>3. Medical Microbiology by Cruickshank and others. ELBS Publications</li> <li>4. Experimental Microbiology by R. J. Patel. Aditya Publishers, Ahmedabad</li> <li>5. Laboratory Methods in Food Microbiology by Harrigan, Academic Press</li> <li>6. Identification Methods for Microbiologists by B. M. Gibbs and F. A. Skinner. Academic Press</li> <li>8. Laboratory Microbiology by L. Jack Bradshaw. W. B. Saunders &amp; Co.</li> <li>9. Benson's Microbiological Applications: Laboratory Manual in General Microbiology by Alfred E. Brown</li> <li>10. Microbiological Methods by Michael Collins</li> <li>11. Handbook of Microbiological Media by R. M. Atlas. CRC Publications</li> <li>12. Laboratory Exercises in Microbiology by Robert A. Pollock and other</li> <li>13. Applied Microbiology Laboratory Manual by F. Duncan.</li> <li>14. Practical Handbook of Microbiology by Emanuel Golman and Lawrence H. Green, 2nd Ed</li> <li>15. Procedures/Guidelines for the Microbiology Laboratory</li> <li>16. Laboratory Exercises in Microbiology 5<sup>th</sup> ed. Harley Prescott</li> </ol>	
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