

**DEPARTMENT OF LIFESCIENCES**  
**UNIVERSITY OF CALICUT**

**SCHEME OF M.PHIL MICROBIOLOGY**

**2019 Onwards**

Sem.	Course	Title	Marks			Credit
			Ext	Int	Total	
I	MBMP.C01	Instrumentation and research methodology	80	20	100	4
	MBMP.C02	Advanced trends in Microbiology	80	20	100	4
	MBMP.E01	Immunology and medical microbiology	80	20	100	4
	MBMP.E02	Environmental biotechnology				
<b>Total</b>			<b>240</b>	<b>60</b>	<b>300</b>	<b>12</b>
II	<b>Second Semester</b>					
	MBMP(Pr)	Project work	120	30	150	12
		Viva-voce	40	10	50	
<b>Total</b>			<b>160</b>	<b>40</b>	<b>200</b>	
<b>Grand Total</b>			<b>400</b>	<b>100</b>	<b>500</b>	<b>24</b>

**DEPARTMENT OF LIFE SCIENCES**  
**M.PHIL MICROBIOLOGY SYLLABUS**

**Core courses**

1. **MBMP. C01: Instrumentation and research methodology**
2. **MBMP. C02: Advanced trends in Microbiology**

**Elective courses (any one of the following)**

1. **MBMP. E01: Immunology and medical microbiology**
2. **MBMP. E02. Environmental biotechnology**

**MBMP. C01: INSTRUMENTATION AND RESEARCH  
METHODOLOGY**

Fundamental procedures used in a microbiology laboratory; Instrumentation, Colorimetry - Visible - UV spectrometry; separation techniques chromatography: TLC, paper, gas, column, ion exchange, HPLC, GC-MS, MS/MS, MALDI-Tof, Surface plasmon resonance, Affinity chromatography. Electrophoresis: PAGE, agarose gel electrophoresis, 2D-PAGE. Centrifugation -principles, types, applications. Ultracentrifugation.

Molecular tools and their applications – restriction and modification enzymes; cloning vectors, DNA primers, Linkers , Adaptors and their chemical synthesis; Nucleic acid amplification methods - PCR-Types- Nested PCR, Real time PCR; RFLP; RAPD and AFLP analysis; Protein and nucleic acid sequencing; Nucleic acid microarrays .

Advanced diagnostic procedures in microbiology – culture confirmation techniques ;direct detection probes; diagnostic sequencing; molecular typing methods; pulse field gel electrophoresis; pcr based typing methods; genotyping bacteria by using VNTR. Agglutination and precipitation –EIA, ELISA, Immunofluorescence, RIA, chemiluminescence, blotting technique (western, southern, northern), flow cytometric assays. Automation in diagnostic microbiology.

Philosophy of science. Ethics and scientific conduct. Ethics in human and animal studies. Publications and Patents. Research methodology: strategies, planning and analysis.

Literature search and personal reference databases. Research theory- inductive and deductive reasoning, hypothetico-deductive reasoning. Research problem, Research design, sampling design, Measurement and Scaling Techniques, Nature and Types of data, methods of data collection, processing and analysis of data, data presentation: graphs, tables, histograms and pi diagrams testing of hypotheses, interpretation and scientific report writing.

### References

1. Vasantha pattabhi and N. Gautham. Biophysics. Kluwer academic publishers. 2002
2. Bengt Nölting. Methods in modern biophysics. 2nd edn.springer-verlag berlin heidelberg. 2006
3. David Sheehan. Physical biochemistry: principles and applications 2nd edn. john wiley & sons ltd. 2009
4. Thomas Jue. Biomedical applications of biophysics. Vol 3. Humana press. 2010
5. Rodney F. Boyer. Modern experimental biochemistry. 3rd edn. 2000
6. Keith Wilson and John Walker. Principles and techniques of biochemistry and molecular biology 7th edn. Cambridge university press. 2010
7. Bailey and Scott's Diagnostic microbiology – Baron *et al*
8. Diagnostic Microbiology-V- Edition. Elmer .Keneman, Stephen D.Allen, William M. Janda.
9. Manual of clinical microbiology-8<sup>th</sup> Edition.Volume –1.Patrick R Murray, Ellen JO Baron, James .H. Jorgensen.
10. Molecular microbiology-Diagnostic principles&Practices-1<sup>st</sup> Indian reprint. David. H. Persing, Fred.C.Tenover.
11. Yi-Wei Tang., Charles W. Stratton. Advanced Techniques in Diagnostic Microbiology. Springer(2006)
12. C R Kothari. Research Methodology. New Age International. 2009.
13. Petter Laake & Haakon Breien Benestad & Bjorn Reino Olsen. Research Methodology in the Medical and Biological Sciences. Academic Press. 2007
14. Nicholas Walliman. Research Methods: The Basics. Routledge. 2010
15. Janice R. Matthews & Robert W. Matthews. Successful Scientific Writing: A Step-By-Step Guide for the Biological and Medical Sciences. Leiden: Cambridge University Press, 2007.

### **MBMP. C02: ADVANCED TRENDS IN MICROBIOLOGY**

1. Microbial taxonomy – Advanced molecular approaches in microbial classification. Molecular approaches. Archea - methanogens, the halophiles, the hyperthermophiles and the genus *Thermoplasma*, their importance.
2. Microbial growth and control, disinfectants and antibiotics and their chemical functions, New generation antibiotics; Evaluation of antimicrobial compounds.
3. Microbial ecology of foods, Advanced techniques of food processing and preservation; Emerging food borne diseases; Procedures to use during outbreaks of food borne diseases; Molecular and biosensor based approaches for the detection of foodborne

pathogens; Genetically modified foods; Probiotics and Prebiotics; Microorganisms as Alternative energy source; HACCP.

4. Bioprocess Techniques; Bioreactors – instrumentation and process control; Media for fermentation; Solid State fermentation - Submerged fermentation. Strain improvement. Downstream processing Protein engineering and metabolic engineering. Strategies for Fermentation Medium Optimization (one-factor-at-a-time, response surface methodology)
5. Cells of the immune system, specific immune responses, including B- and T-cells, macrophages, immunoglobulins, immunoglobulin genetics, and major histocompatibility proteins. Principal adverse aspects of the immune system, concentrating on the major hypersensitivities. Novel Vaccine Technologies, Recombinant vaccines and the development of new vaccine strategies, Edible Vaccines: Applications, Advantages and Limitations.
6. Molecular biology and genetics: Genome editing and CRISPR-Cas9, Transcriptome analysis, Antisense technology and its applications, Biocontainment of Genetically Modified Organisms. Mechanism of gene transfer methods in prokaryotes (Conjugation, Transformation & transduction), Establishment and maintenance of repression by bacteriophage lambda, Genetic Recombination and Gene Mapping.

## References

1. Christopher Walsh. *Antibiotics: Actions, Origins, Resistance*. Amer Society for Microbiology; 1 ed. 2003
2. James M. Jay & Martin J. Loessner & David A. Golden. *Modern Food Microbiology* Seventh Edition. Springer. 2005
3. Bibek Ray & Arun K. Bhunia. *Fundamental Food Microbiology*. CRC Press. 1996
4. Martin R. Adams & Maurice O. Moss. *Food Microbiology*. Royal Society of Chemistry. 2008
5. Frazier, W.C. and Westhoff, D.C. *Food Microbiology* 4<sup>th</sup> Edn. TATA McGraw Hill Publishing company Ltd., New Delhi. 1988
6. Murray and Moo-Young. *Comprehensive biotechnology 2<sup>nd</sup> edn*. Elsevier B.V. 2011.
7. Wulf Crueger and Anneliese Crueger. *Biotechnology: A Textbook of Industrial Microbiology*. Sinauer Associates Inc; 2 Sub edition. 1990
8. Richard H. Baltz, Julian E. Davies and Arnold L. Demain. *Manual of Industrial Microbiology and Biotechnology*. Amer Society for Microbiology; 3 edition. 2010
9. P F STANBURY, S. Hall and A. Whitaker. *Principles of Fermentation Technology*, Second Edition. Butterworth-Heinemann; 2 edition. 1999 Fundamentals of biotechnology – Ed. Paul Prave *et al.*,
10. Delves PJ, Martin SJ, Burton DR, Roitt IM; *Roitt's Essential Immunology* 11<sup>th</sup> edition. Blackwell

Publishing/Oxford Univ. Press; 2006.e

11. Kindt TJ, Goldsby RA, Osborne BA, Kuby J: ***Kuby Immunology*** 6th edition. New York. WH Freeman; 2006.
12. C.K. Jayaram Paniker, R. Ananthanarayan. ***Ananthanarayan and Paniker's Textbook of Microbiology***

## **MBMP. E01: IMMUNOLOGY AND MEDICAL MICROBIOLOGY**

1. Microbial pathogenicity- sources and spread of infections in the community; Epidemiology of infectious diseases; Emergence of multidrug resistance pathogens; Mechanisms and genetics of drug resistance; Special tests for detecting resistance, Instrument based techniques.
2. Humeral and cell mediated immune response. Cells of immune system, lymphoid organs, lymphocyte traffic, T and B cells – Structure, function, maturation and development. Genetics of immune response.
3. Transplantation & tumor immunology, immunological tolerance, immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections, congenital and acquired immunodeficiencies,
4. Lymphokines and cytokines. Processing and presentation of intracellular and extracellular antigens. Immune response to T-dependent and T independent antigens. Major histocompatibility complex.
5. Immunoglobulin structure & classes. Antigen-antibody reactions and their applications in immunodiagnosis. autoimmune diseases, hypersensitivity reactions. immunodeficiency diseases. Immunotherapy for cancer. Vaccines- Types and characteristics of vaccines; Principles and effects of vaccination; Vaccine designing.
6. Symptomatology, epidemiology, preventive measures of disease – Hepatitis,-A,B,E, HIV, Tuberculosis, Enteric fever, Weil's disease, Emerging disease-s Dengue fever, Chikungunya, Swine flu, Hand, Foot and Mouth disease. Factors that contribute to the emergence and re-emergence of the infectious diseases, Mechanism of emergence of new pathogens, Nipah and Zika Virus Infection.

### **References**

1. Eli Benjamini, Geoffrey Sunshine, Sydney Leskowitz. ***Immunology a short course***. Wiley Liss Publications.
2. Delves PJ, Martin SJ, Burton DR, Roitt IM; ***Roitt's Essential Immunology*** 11<sup>th</sup> edition. Blackwell Publishing/Oxford Univ. Press; 2006.e
3. Kindt TJ, Goldsby RA, Osborne BA, Kuby J: ***Kuby Immunology*** 6th edition. New York. WH Freeman; 2006.
4. Janeway CA, Travers P, Walport M, Shlomchik MJ: ***Immunobiology: The immune system in health and disease*** 6th edition. New York. Garland Science Publishing; 2005.
5. Levinson W, Jawetz E: ***Medical Microbiology and Immunology***. Lange publication; 2001.

6. Helen Chapel, Mansel Haeney, Siraj Misbah, Neil Snowden. *Essentials of Clinical Immunology*, 5th Edition. Wiley-Blackwell. 2006
7. William E. Paul. *Fundamental immunology*. Seventh Edition 2012
8. C.K. Jayaram Paniker, R. Ananthanarayan. *Ananthanarayan and Paniker's Textbook of Microbiology* Universities Press (India) Pvt. Ltd., Orient Longman Limited. 2009.
9. Thomas Jones Mackie, J. G. Collee, James Elvins McCartney. *Medical Microbiology*. Churchill Livingstone, 1989
10. Ellen JO Baron and Patrick R Murray. *Manual of clinical microbiology-9<sup>th</sup> Edition. Volume –1*. ASM Press. 2007

## **MBMP. E02. ENVIRONMENTAL BIOTECHNOLOGY**

1. Role of bacteria in diverse terrestrial and aquatic ecosystems, including nutrient recycling, symbiotic relationships, and adverse effects on certain ecosystems (acid mine drainage, mercury mineralization, ore leaching). Carbon, Nitrogen and Sulfur Cycling; Assorted biogeochemistry. Biotechnology in marine ecology.
2. Interactions among microbial populations; Plant-microbe interactions; Microbe-animal interactions; Development of microbial communities; Measurement of biomass and microbial activity; Microbial Diversity – phylogenetic, physiologic and metabolic; Waste treatment / Water quality, Biofuels; Microbial fuel cells. Biocontrol, Industrial microbiology.
3. Biodegradation/bioremediation; isolation and screening bioremediation's microbes, organic compound contaminants bioremediation, heavy metal and xenobiotic compounds bioremediation, hydrogen bioremediation, and engineering techniques used in bioremediation, Infectious waste management; Waste water treatment using living systems.
4. Microbial Biomineralization, Biomining, Microbial ore leaching, Magnetotactic bacteria, magnetosomes and their application, Biogas Technology: towards sustainable development, Bioaugmentation as a strategy for the remediation of pesticide-polluted soil, Biosynthesis of Nanoparticles by Microorganisms and Their Applications
5. Industrial products produced by microbes, including yeast, steroid bioconversions, and large-scale productions of alcohol, foods, enzymes, vitamins, antibiotics, food additives,

and chemicals. Cellulose and lignocellulose to ethanol, antibiotic production. Application of tropical agro-industrial residues as substrate for industrial fermentation processes.

6. Impacts of genetically modified organisms on biodiversity and human health. Ethical and biosafety considerations. Socio-economic impacts of GMOs.

## References

1. Hans-Jürgen Rehm & Gerald Reed & Josef Winter. *Biotechnology, 2E, Vol.11A, Environmental Processes* I. VCH. 1999.
2. Ralph Mitchell & Ji-Dong Gu. *Environmental Microbiology*. Wiley-Blackwell. 2009
3. Eugene L. Madsen . *Environmental Microbiology: From Genomes to Biogeochemistry*. Wiley-Blackwell. 2008.
4. Myung-Bo Kim. *Progress in Environmental Microbiology*. Nova Biomedical Books. 2008
5. Uma Shankar Singh and Kiran Kapoor. *Microbial Biotechnology*. Oxford book company, Jaipur, India. 2010.
6. HJ Reham and G. Reed *Biotechnology (A multi-volume comprehensive treatise). Second Editon. Vol 1. Biological fundamentals*. VCH publishing house mbH. 1993.
7. Alexander N. Glazer and Hiroshi Nikaido. *Microbial biotechnology fundamentals of applied microbiology, second edition*. Cambridge University Press. 2007.
8. Murray and Moo-Young. *Comprehensive biotechnology 2<sup>nd</sup> edn*. Elsevier B.V. 2011.
9. Wulf Crueger and Anneliese Crueger. *Biotechnology: A Textbook of Industrial Microbiology*. Sinauer Associates Inc; 2 Sub edition. 1990
10. Richard H. Baltz, Julian E. Davies and Arnold L. Demain. *Manual of Industrial Microbiology and Biotechnology*. Amer Society for Microbiology; 3 edition. 2010
11. P F STANBURY, S. Hall and A. Whitaker. *Principles of Fermentation Technology*, Second Edition. Butterworth-Heinemann; 2 edition. 1999 Fundamentals of biotechnology – Ed. Paul Prave *et al.*,
12. B.D. Singh. *Biotechnology*. 4<sup>th</sup> Edn. Kalyani, 2010