

2018

# **M.Phil MICROBIOLOGY**

## **Course Structure and Syllabus**

(For the candidates admitted from the academic year 2020-2021 onwards)

## **SEMESTER PATTERN**



**THANTHAI HANS ROEVER COLLEGE (AUTONOMOUS)**

**(Nationally Re-Accredited by NAAC with B<sup>++</sup>)**

**(Affiliated to Bharathidasan University, Tiruchirappalli)**

**ELAMBALUR, PERAMBALUR – 621 220**



**THANTHAI HANS ROEVER COLLEGE (AUTONOMOUS)**  
**PERAMBALUR – 621 220**  
**SYLLABUS**

**M.Phil MICROBIOLOGY**

Semester	Title of the paper / Subject Code	Marks			Credits
		IM*	EM*	Total	
<b>Semester – I</b>					
Course – I	Research Methodology / 18MPMB1CC1	25	75	100	4
Course – II	Advanced Microbiology / 18MPMB1CC2	25	75	100	4
Course – III	Teaching and learning skills / 18MPMB1CC3	25	75	100	4
Course – IV	Paper on topic of research / 18MPMB1CC4 (Guide will prepare the syllabus and it will be sent to the COE)	25	75	100	4
<b>Semester – II</b>					
	Dissertation and Viva-voce Viva voce 50 marks Dissertation 150 marks / 18MPMB2DW	--	--	200	8
<b>Total</b>				<b>600</b>	<b>24</b>

*IM\* marks – Internal assessment marks; EM\* marks – External marks*

**Note**

Particulars	Internal	External
Theory	25 Marks	75 Marks

**Separate passing minimum is prescribed for internal and external**

- The passing minimum for CIA shall be 40% out of 25 marks (i.e. 10 marks)
- The passing minimum for University Examinations shall be 40% out of 75 marks (i.e. 30 marks)
- The passing minimum not less than 50% in the aggregate

**Question paper pattern for Theory Course**

- 10 Questions compulsory- 10 x 02 = 20 Marks (2 from each unit)
- 5 Questions - 05 x 05 = 25 Marks (either or type, one from each unit)
- 3 Questions from 5 - 03 x 10 = 30 Marks (One question from each unit)
- Total - 75 Marks

**CIA components**

- Best 2 tests out of 3 - 10 Marks
- Attendance - 05 Marks
- Seminar - 05 Marks

- Assignment - 05 Marks
- Total - 25 Marks

## SEMESTER-I

Course Code: 18MPMB1CC1  
Credits: 4

Exam Hours: 3  
Internal Marks: 25  
External Marks: 75

### COURSE 1– RESEARCH METHODOLOGY

#### Objectives:

- To learn the writing of scientific articles
- Importance of the advanced instruments and their simple operating procedure (SOP)
- To gain the knowledge on modern molecular techniques

#### Course Outcomes:

- Learners will understand research, research methods, preparation of research reports, research articles, books, book chapters, impact factors, citation index.
- Acquiring knowledge on experiment design and hypothesis.
- Students would acquire knowledge on different types of instruments and techniques.
- Acquiring knowledge on molecular and insilico techniques
- Obtaining knowledge on Biosafety and IPR

#### Unit I

**Introduction of Research:** Research: Types, research process and steps in it, hypothesis, research proposals and aspects. Research design: need, problem definition, sampling procedures, variables, research design concepts, literature survey and review, research design process, errors in research. Research modeling: Types of models, model building and stages, data consideration and testing, heuristic and simulation modeling. Report writing: Pre-writing considerations, thesis writing, formats of report writing, formats of publications in research journals – JCI – impact factor and h-index.

#### Unit II

**Design of Experiments:** Design of experiments: Objectives, strategies, factorial experimental design, designing engineering experiments, basic principles - replication, randomization, blocking, guidelines for design of experiments. Single factor experiment: Hypothesis testing, analysis of variance components (ANOVA) for fixed effect model; Total, treatment and error of squares, degrees of freedom, confidence interval; ANOVA for random effects model, estimation of variance components, model adequacy checking. Two factor factorial design, basic definitions and principles, main effect and interaction, response surface and contour plots, general arrangement for a two-factor factorial design; Models - effects, means and regression, hypothesis testing.

#### Unit III

**Advanced instrumentations:** GC-MS - HPLC - NMR, Fluorescence, Atomic Absorption, CD, ORD, Mass, Raman Spectroscopy – PFGE – MALDI-ToF, TEM and SEM

#### Unit IV

**Molecular and in-silico techniques:** Denaturing Gradient Gel Electrophoresis (DGGE), Terminal Restriction Fragment Length Polymorphism (T-RFLP), Amplified Ribosomal DNA and Restriction Analysis (ARDRA). Microbial sequence analysis. Preparation of ordered cosmid libraries, bacterial artificial chromosomal libraries, shotgun libraries and sequencing, conventional sequencing (Sanger, Maxam and Gilbert Methods), next-generation sequencing methods - Sequence analysis: Computational methods, homology algorithms (BLAST) for proteins and nucleic acids, open reading frames, annotations of genes, conserved protein motifs related structure / function (PROSITE, PFAM, Profile Scan). DNA analyses for repeats (Direct and inverted), palindromes, folding programmes. Use of Internet, public domain databases for nucleic acid and protein sequences (EMBL, GeneBank), database for protein structure (PDB).

#### Unit V

**Biosafety and IPR:** Biosafety levels – IBC – Institutional ethical committees – Good Laboratory

Practices and Good Manufacturing Practices – regulations on rDNA products - commercialization – copy right – trademark - designs – royalty - Intellectual Property Rights and patent law – patent laws in India - WTO – Trade related aspects of Intellectual Property Rights – Patents – conditions for patentability – composition of a patent – patenting of microorganisms – Ethics in science reporting - Reproduction of published material – Plagiarism - Citation and acknowledgement.

## References

1. Krishnamurthy, K.V (2007) Scientometrics. BDU Journal of Science & Technology Vol.I (2) 153 – 168.
2. Gurumani, N. (2007). Research Methodology. MJP Publishers, Chennai – 600 005.
3. John G Webster (2004).Bioinstrumentation .Student edition, John Wiley &sons, Ltd.
4. Keith Wilson& John Walker (2003) Practical Biochemistry Principles-tech.5th edition, Cambridge university press.
5. Montgomery, Douglas C. & Runger, George C. (2007), 3/e, Applied Statistics & Probability for Engineers (Wiley)
6. Manual of patent practice and procedure. IPR India, 2005. Ministry of commerce and industry, New Delhi, pp.163.
7. Biotechnology and safety assessment, John.A.Thomas, 2004. pp.333

## Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
I	18MPMB1CC1	Research Methodology						4			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓		✓	✓		
CO2	✓		✓	✓		✓	✓	✓	✓		
CO3	✓	✓	✓		✓	✓	✓	✓	✓	✓	
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓		✓	✓		
Number of Matches(✓) = 42 Relationship: High											

<b>Mapping</b>	1-29%	30-59%	60-69%	70-89%	90-100%
<b>Matches</b>	1-14	15-29	30-34	35-44	45-50
<b>Relationship</b>	Very Poor	Poor	Moderate	High	Very High

## SEMESTER-I

Course Code: 18MPMB1CC2  
Credits: 4

Exam Hours: 3  
Internal Marks: 25  
External Marks: 75

### COURSE 2 – ADVANCED MICROBIOLOGY

#### Objectives:

- To get familiar with products obtained from microorganisms.
- To understand the concept of genomics and metagenomics.
- To impart knowledge on microbial nanotechnology.

#### Course Outcomes:

- Students would knowledge in microbial products, process of biodegradation, microbial fuels.
- Students would learn about tools in genome analysis, genome mapping and genome sequencing.
- Students acquire knowledge on proteomics, protein identification.
- Students would obtain a comprehensive idea about the process of drug designing
- Scholars would understand Nanoparticles. Synthesis of nanodrugs and drug delivery

#### Unit I

**Microbial Technology:** Production of useful products through microbial & recombinant microbes – insulin, vaccines, antibiotics, SCP (Spirulina & Mushroom) and Biofertilizers (Cyanobacteria, Azospirillum & VAM). Biodegradation of organic wastes and xenobiotic compounds – heavy metals, pesticides, insecticides. Microbial leaching. Microbial Biofuels - hydrogen production. Biodiesel - biodegradation of oils and petroleum products.

#### Unit II

**Genomics and metagenomics :****Genomics:** Historical prospective and strategies of genomics. Genome Structure: genome sizes – microbial and organelle genome – genome physical mapping and sequencing – tools in genome analysis; Structural and functional annotations of genes and genomes. Human, plant, animal and microbial genomes. Human Microbiome project. **Metagenomics** – definition – principles – methods - whole genome shotgun sequencing – pyrosequencing – metagenomic library production – high throughput screening - Environmental Gene Tags (EGTs).

#### Unit III

**Proteomics :** Proteome - Primary attributes for protein identification - protein species of origin - Protein N- and C-terminal sequence tags - cross species protein identification - Modifications that influence protein change on 2-D PAGE - Detection and analysis of co- and post-translational modification – Applications of proteomics

#### Unit IV

**Drug designing:** Sources of Drugs - History of drug design, microbial drugs, E. coli as a source of recombinant therapeutic proteins. Expression of recombinant proteins in yeasts, animal cell culture systems. Additional production systems: Fungal production systems, transgenic animals, transgenic plants and Insect cell-based systems. Drug development process - Impact of genomics and related technologies upon drug discovery: Gene chips, Proteomics, Structural genomics and Pharmacogenetics. Drug manufacturing process - Guides to good manufacturing practice, Production of final product - Cell banking systems, Upstream processing, Microbial cell fermentation and Downstream processing.

#### Unit V

**Microbial nanotechnology:** History, microbial synthesis of Nanoparticles. Synthesis of nanodrugs – metal nanoparticles and drug delivery vehicles – Nanoshells – Tectodentrimers Nanoparticle drug systems – Diagnostic applications of nanotechnology. Preparation of nanobiomaterials – Polymeric scaffolds collagen, Elastins: Mucopolysaccharides, proteoglycans, cellulose and derivatives; Dextran; Alginate; Pectin; Chitin. Nanoparticles – types, functions – Silver, Gold and Titanium. Physical and chemical properties of nanoparticles.

### References

1. Doolittle RF. (1990). Molecular evolution. Computer Analysis of Protein and Nucleic acid Sequences Methods in Enzymology. Academic Press, New York.
2. Glick BR, Pasternak JJ (1998) Molecular Biotechnology - Principles and Applications of Recombinant DNA, ASM Press, Washington DC
3. Baxevanis AD and BFF Ouellette, Wiley O. (ed) (2001) Bioinformatics – A practical guide to the analysis of genes and proteins. Interscience, New York,
4. Povl Krogsgaard-Larsen, Ulf Madsen and Kristian Stromgaard. Textbook of Drug Design and Discovery, Fourth Edition, CRC press, 2009.
5. Primrose, Principles of Genome analysis. Blackwell Sciences.2003.

### Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
I	18MPMB1CC2	Advanced Microbiology						4			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓	✓	✓	✓	✓	
CO2		✓		✓	✓	✓		✓	✓	✓	
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO4	✓		✓	✓	✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓		✓	✓	✓	
Number of Matches(✓) = 44 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

## SEMESTER-I

Course Code: 18MPMB1CC3  
Credits: 4

Exam Hours: 3  
Internal Marks: 25  
External Marks: 75

### COURSE 3 – TEACHING AND LEARNING SKILLS

#### Objectives:

- Acquaint different parts of computer system and their functions
- Understand the operations and use of computers and common accessories
- Acquire the knowledge of communication skill with special reference to its elements, types, development and styles

#### Course Outcomes:

- Develop skills of ICT and apply them in teaching Learning context and Research
- Learn how to develop communication skill with special reference to Listening, speaking, reading and writing.
- Acquire how to use instructional technology effectively in a class
- Develop adequate skills and competencies to organize seminar, conference, Workshop, Symposium and Panel Discussion
- Scholars would understand Have the ability to utilize different teaching skills for putting the content across to targeted audience.

#### Unit I

**Computer Application Skills:** Computer system: Characteristics, Parts and their functions – Different generations of Computer – Operation of Computer: switching on / off / restart, Mouse control, Use of key board and some functions of key – Information and Communication Technology (ICT): Definition, Meaning, Features, Trends – Integration of ICT in teaching and learning – ICT applications: Using word processors, spread sheets, Power point slides in the classroom – ICT for Research: On-line journals, e-books, Courseware, Tutorials, Technical reports, Theses and Dissertations

#### Unit II

**Communication Skills:** Communication: Definitions – Elements of Communication: Sender, Message, Channel, Receiver, Feedback and Noise – Types of Communication: Spoken and written; Non-verbal communication – Intrapersonal, Interpersonal, Group and Mass communication – Barriers to communication: Mechanical, Physical, Linguistic & Cultural – Skills of communication: Listening, Speaking, Reading and writing – Methods of developing fluency in oral and written communication – style, Diction and Vocabulary – Classroom communication and dynamics

#### Unit III

**Communication Technology:** Communication Technology: Bases, Trends and Developments – Skills of using Communication Technology – Computer Mediated Teaching: Multimedia, E-content – Satellite-based communication: EDUSAT and ETV channels, Communication through web: Audio and Video applications on the Internet, interpersonal communication through the web.

#### Unit IV

**Pedagogy:** Instructional Technology: Definition, Objectives and Types – Difference between Teaching and Instruction – Lecture Technique: Steps, Planning of a Lecture, Delivery of a lecture – Narration in tune with the nature of different disciplines – Lecture with power point presentation – Versatility of lecture technique – Demonstration, Characteristics, Principles, Planning Implementation and Evaluation – Teaching – Learning Techniques: Team Teaching, Group discussion, Seminar, Workshop, Symposium and Panel Discussion – Models of teaching: CAI, CMI and WBI

#### Unit V

**Teaching Skills:** Teaching skill: Definition, Meaning and Nature – Types of Teaching skills: Skill of

Set Induction, Skill of Stimulus Variation, Skill of Explaining, Skill of Probing Questions, Skill of Black Board writing and Skill of Closure – Integration of Teaching Skills – Evaluation of Teaching Skills

### References

1. Bela Rani Sharma (2007), Curriculum Reforms and Teaching Methods, Sarup and sons, New Delhi
2. Don Skinner (2005), Teacher Training, Edinburgh University Press Ltd., Edinburgh
3. Information and Communication Technology in Education: A Curriculum for Schools and programme of Teacher development, Jonathan Anderson and Tom Van Weert, UNESCO, 2002
4. Kumar K.I (2008) Educational Technology, New Age International Publishers, New Delhi
5. Mangal, S.K. (2002) Essential of Teaching – Learning and Information Technology, Tandon Publications, Ludhiana
6. Pandy, S.K (2005) Teaching communication, commonwealth publishers, New Delhi.

### Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
I	18MPMB1CC3	Teaching and Learning Skills						4			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓		✓	✓	✓	✓		✓	
CO3	✓	✓		✓	✓	✓	✓	✓	✓	✓	
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO5	✓	✓		✓	✓	✓	✓	✓	✓		
Number of Matches(✓) = 45 Relationship: Very High											

<b>Mapping</b>	1-29%	30-59%	60-69%	70-89%	90-100%
<b>Matches</b>	1-14	15-29	30-34	35-44	45-50
<b>Relationship</b>	Very Poor	Poor	Moderate	High	Very High



## SEMESTER-I

Course Code: 18MPMB1CC4  
Credits: 4

Exam Hours: 3  
Internal Marks: 25  
External Marks: 75

### COURSE 4 – INDUSTRIAL MICROBIOLOGY

#### Objectives:

- Acquaint basics of industrial microbiology
- To learn the screening of industrial strains, fermenters
- Acquire the knowledge of fermented microbial products

#### Course Outcomes:

- Develop skills of detection and assay of fermented products
- Learners would understand the design, function and components of fermenter.
- Acquire how to recover and purify microbial intracellular and extracellular products
- Enable adequate skills in the manufacture of SCP.
- Scholars would understand the commercial production of antibiotics, enzymes and organic acids.

#### Unit I

**Basics of Industrial microbiology:** Industrially important microbes and their improvement: Screening methods for industrial microbes – detection and assay of fermentation products– classification of fermentation types – strain selection and improvement. Mutation and recombinant DNA techniques for strain improvement. Preservation of cultures after strain improvement

#### Unit II

**Fermenter:** Fermenters – Basic functions, design and components – asepsis and containment requirements – body construction and temperature control – aeration and agitation systems – sterilization of fermenter, air supply, and medium; aseptic inoculation methods – sampling methods, valve systems – a brief idea on monitoring and control devices and types of fermenters. Photobioreactor

#### Unit III

**Downstream and upstream process:** Up-stream processes – Strain selection, cultivation, seed preparation, fermentation media formulation strategies, role of physical and other parameters for microbial growth, types of fermentation. Down-stream processes - The recovery and purification of fermentations products (intracellular and extracellular), cell disruption, precipitation, filtration, centrifugation, solvent recovery, chromatography, ultrafiltration, drying and etc.

#### Unit IV

**Industrial Microbial products:** Fermented foods- Milk and dairy products, plant products- Sauerkraut and fermented olives, breads. Microbial cells as food- SCP, mushroom cultivation. Source and applications of antioxidants, bio-surfactants, organic acids. Industrial enzymes production (amylase and proteases), biopolymer (bioplastics), production of antibiotics - penicillin and streptomycin, interferon, insulin and vaccines.

#### Unit V

**Probiotic technology:** Definition-history-Different terminology- Pre-biotic, probiotic, symbiotic. Sources of Probiotics - Dairy products, Vegetables, Fruits, fermented foods- koozh. yoghurt Probiotic strains -Lactic acid bacteria (LAB): Lactobacillus, Leuconostoc, Lactococcus and Streptococcus - Bacillus -Enterococcus- Mechanism of action - Production of specific substances (organic acid and bacteriocins), Competitive adhesion to epithelial receptors, Modification of microbial population, Modulation of immune system, Reduction in inflammation, Aggregation with pathogenic bacteria - Application of probiotics- Enhancement of resistance against pathogens,

Stimulation of immune system, Lactose intolerance, Prevention of reduction of constipation, Prevention of diarrhea- Future prospects of probiotics.

## REFERENCES

- 1 Casida LE Jr. Industrial Microbiology, 5th edition, Wiley Eastern Ltd., New Delhi. 1993
- 2 Crueger W and Crueger A. Biotechnology: A Test Book of Industrial Microbiology, 2nd edition. Panima Publishing corporation, New Delhi. 2000.
- 3 Glazer NA and Nikaido H. Microbial Biotechnology: Fundamentals of Applied Microbiology 2nd edition, Cambridge University Press. 2007.
- 4 Pandey A, Soccol RC and Larroche C. Current Developments in Solid-state Fermentation. Springer Verlag. 2008.
- 5 Patel AH. Industrial microbiology. Published by Mac Millan India Ltd., Chennai. 2005.
- 6 Peppler HJ and Pearlman D. Microbial Technology – Fermentation Technology. Vol.1 and 2, 2nd edition, Academic Press, London. 2004.
- 7 Prescott LM, Harley JP and Helin DA, Microbiology, fifth edition, McGraw Hill, New Delhi. 2002. International Publishers, New Delhi
- 8 Sivakumar PK, Joe MM and Sukesh K. An introduction to Industrial Microbiology. First edition, S. Chand and Company Ltd, New Delhi. 2010.
- 9 Stanbury PF, Whitaker A and Hall SJ. Principles of Fermentation Technology, second edition, Aditya Book (p) Ltd., New Delhi. 1999.
- 10 Susan SC and Terry F (2009). Handbook of Prebiotics and Probiotics Ingredients: Health Benefits and Food Applications, CRC Press Publisher.
- 11 Wolfgang K and Seppo S (2011). Probiotics and Health Claims, John Wiley and Sons Publication.

## Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
I	18MPMB1CC4	Industrial Microbiology						4			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO2	✓			✓	✓	✓	✓	✓	✓		
CO3	✓	✓	✓		✓	✓		✓	✓	✓	
CO4	✓	✓	✓		✓	✓		✓		✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 42 Relationship: High											

<b>Mapping</b>	1-29%	30-59%	60-69%	70-89%	90-100%
<b>Matches</b>	1-14	15-29	30-34	35-44	45-50
<b>Relationship</b>	Very Poor	Poor	Moderate	High	Very High