

**Ph.D. MICROBIOLOGY  
COURSE WORK**  
(With effect from the Academic Year 2020-2021)



**Department of Biology**  
**The Gandhigram Rural Institute (Deemed to be University)**  
(Ministry of Education, Govt. of India)  
Accredited by NAAC with 'A' Grade (3<sup>rd</sup> Cycle)  
Gandhigram- 624 302  
Dindigul District, Tamil Nadu

## Ph.D MICROBIOLOGY SCHEME

<b>FIRST SEMESTER</b>							
	<b>Course Code</b>	<b>Course title</b>	<b>C</b>	<b>L</b>	<b>E</b>	<b>ESE</b>	<b>Total</b>
<b>Core Courses</b>	21MIBR0101	Research Methodology	4	4	3	100	100
	21MIBR0102	<i>Basic Courses in the Subject Area*:</i> Recent Trends in Microbiology	4	4	3	100	100
	21MIBR0103	Area of Specialization**	4	4	3	100	100
	21MIBR0104	Research and Publication Ethics	2	2	3	100	100
		<b>Total Credits</b>	<b>14</b>				

**C- Credits    L-Lecture Hours    E- Exam Hours    CFA- Continuous Formative Assessment,  
ESE – End Semester Exam**

21MIBR0103	<b>SPECIALIZATION COURSE</b>	<b>CREDITS: 4</b>
** Detailed Syllabus for Area of Specialization will be prepared by the respective Doctoral Committee.		

**Objectives:**

To enable the students:

- To understand the working principles, construction and applications of the instruments used in the studies related to various disciplines of biological sciences.
- To expose the students on the basic understanding of research concepts and learn the art of thesis & paper writing, publication and scientific ethics.
- To apply a variety of statistical procedures and tests.

**Learning outcomes:**

On completion of the course, the scholars should be able to

- realize the importance of pH meter and various Microscopes.
- understand the working principle, operation system and importance of centrifuge, photometers and chromatography.
- develop skills on molecular techniques.
- acquire knowledge on the overall concepts of Research and art of writing Thesis
- develop art of writing research articles, projects, and publication
- critically assess data collection and its representation

**Unit I : pH meter, microscopic and polarimetric techniques:**

pH meter - types, basic principle, operation and application; Buffers-principle, standards and preparation of buffer; pH determination & pH indicators. Microscopy – Principle, operation and application - simple, compound, light-field, dark-field, phase-contrast, fluorescence, confocal and electron microscopy. Micrometry-principle and application. Polarimetry -principle and application.

**Unit II : Centrifuge, Photometric and Chromatographic techniques:**

Centrifugation-types, principle and application. Photometry - Principle, operation and application-colorimeter, spectrophotometer, flame photometer, bomb calorimeter, UV-Visible spectroscopy, atomic absorption spectroscopy, mass spectroscopy and FTIR spectroscopy. Chromatography– types, principle and application: paper chromatography, thin layer chromatography, column chromatography, Ion Exchange, GC-MS and HPLC.

**Unit III: Molecular techniques:**

Electrophoresis - Principle and applications, paper electrophoresis, agarose gel-Polyacrylamide gel electrophoresis (PAGE and SDS- PAGE) and immuno electrophoresis. Molecular techniques- Microarray, MALDI-TOF, Amino acid sequencing-DNA sequencing (Enzymatic & Chemical methods) Blotting techniques-southern, northern and western blottings and PCR techniques. RAPD, RFLP and ARDRA techniques.

#### **Unit IV : Research, Thesis writing, Publication and Project Writing:**

Research –definition, objectives, types and importance – Research methods in biological Sciences –Research process – Literature survey – sources – scientific databases – Research report writing – Parts of thesis and Dissertation – Writing scientific paper-Publication on research journals – Standards of research journals – peer review – impact factor –citation index. Proof correction – proof correction marks –Method of correction proof. Writing chapters in books. – Preparation of Research proposal and funding agencies – Research fellowships

#### **Unit V : Statistical Methods**

Sample Methods – Sampling Techniques, Determination of Sample size- Merits and demerits of sampling – student's test, chi-square test – Correlation Techniques – Simple correlation and Regression – Multiple correlation and Regression Analysis – Types of data – Measures of central value- Variability of Measures, Skewness measures and ANOVA- Computational Tools: SPSS, MATLAB and DMRT.

#### **References:**

1. N.Gurumani.2019. An Introduction to Biostatistics. MJP Publishers, Chennai
2. Pranab Kumar Banerjee.2018. Introduction to Statistics.S.Chand Publishing Company Ltd. New Delhi
3. P.Mariappan.2013. Biostatistics. Pearson,Chennai
4. P.S.S.Sundar Rao and J.Richard.2012. Introduction to Biostatistics and Research Methods.PHI Learning Pvt. Ltd. New Delhi.
5. David.T Plummer (2009). An Introduction to Practical Biochemistry, Tata Mc Graw Hill Pub.Co.Ltd, New Delhi.
6. N.Gurumani (2009).Research Methodology for Biological Sciences. MJP Publishers, Chennai.
7. K.Kannan (2003). Hand book of Laboratory Culture media, reagents, stains and buffers. Panima Publishing Corporation, New Delhi
8. Glick, B.R and Pasternak.J.J.,(2003). Molecular Biotechnology, ASM Press, Washington.DC.
9. P.Asokan (2002).Analytical biochemistry-Biochemical techniques. First Edn. China Publications, Melvishoram, Vellore.
10. Rajbir Singh (2002).Chromatography 1st Edition Mittal Publications, New Delhi.
11. Keith Wilson and John Walker (2002). Practical Biochemistry-Principles and techniques. 5thEd.Cambridge Univ.Press, London.
12. James.D.Watson, Michael Gilman,JanWit Koeski and Mark Zuller(2001). Recombinant DNA. IInd Ed.Scientific American Book. New York.
13. S.Palanichamy and M.Shanmugavelu.(1997). Research methods in biological sciences. Palani Paramount Publications, Palani.
14. Jeyaraman.J.(1981).Laboratory Manual in Biochemistry. New Age International Publishers, New Delhi.

#### **Web resources:**

PubMed search engine for database of references and abstracts on life sciences and biomedical topics: <https://en.wikipedia.org/wiki/PubMed>.

Plagiarism Software: Online plagiarism checker for checking articles: <https://www.plagiarismsoftware.net/> and [www.urkund.com/en/](http://www.urkund.com/en/)

**Objectives:**

This course gives an insight to microbial biotechnology covering topics viz., fermentation, product development trends in bacterial taxonomy, gene technology and its application. It also develops the skills to understand and critically evaluate research activities in various emerging areas of microbiology.

**Learning Outcomes:**

On completion of the course, the scholars should be able to:

- develop in-depth knowledge on fermentation, upstream and downstream processing
- understand the concepts of biotransformation
- acquire knowledge on recent advances in bacterial taxonomy
- develop skills on gene technology and its usefulness for genome sequencing
- realize application of microbial gene technology, bio safety and Bioethics.

**Unit – I:**

Concepts and Scope in microbial bio-technology- Fermentation technology – Model fermenters – bioprocess monitoring – Down stream processing. Immobilization of microbial cells / enzymes – Adsorption, entrapping, ionic bonding, cross linking, encapsulation and microencapsulation. Application of immobilized enzymes. Gene banks and Germ plasm storage.

**Unit-II:**

Biotransformation and production of useful compounds – Glycerol, acetone, Alkene oxide, Poly hydroxy butyrate and Xanthan gum - Microbial Leaching. Bioenergy products – ethanol, biogas and Hydrogen. Bioremediation – microbial degradation of xenobiotics. Biosensors – definition, outline design and types – Biosensors nutrients – glucose and acetic acid sensors. Sensor for cell population – Fuel cell type electrode, potentiostatic, piezoelectric membrane – Dye-coupled electrode membrane filter – Oxygen electrode system and Lactate sensor. Biosensor for products - alcohol sensor, formic acid sensor and methane sensor. Biosensor for environmental control – BOD sensor, Ammonia sensor, Nitrite sensor and Sulfite Ion sensor.

**Unit III:**

Recent advances in Bacterial Taxonomy - Identification of Prokaryotes - phylogenetic backbone and taxonomic framework for prokaryotic systems - road map to the use of the current Bergey's Manual - Computer taxonomy - 16s rRNA fingerprinting and lipid profile by GLC b. Microbial sources of pharmaceutically important compounds. Quorum sensing– intercellular signaling and its uses.

**Unit – IV :**

Microbial Gene Technology: Enzymes - DNA polymerase, restriction endonucleases, topoisomerase I and DNA ligase, reverse transcriptase, kinase, alkaline phosphatase, nuclease, RNAse H. Vectors: plasmids;(PBR 322, pUC, Ti), Cosmids, bacteriophage, M13 vectors, BAC, and YAC - Blotting techniques - DNA sequencing by Maxam & Gilbert's chemical method and Sanger's dideoxy chain termination method - cDNA library – screening by oligonucleotide probe, nick translation, site directed mutagenesis, linkage analysis. Gene cloning - General strategy for gene cloning, transformation. Gene Silencing, Gene knock out and gene therapy.

**Unit-V :**

Applications of microbial gene technology: Genetically modified microorganisms and its applications in the fields of food & dairy industry, agriculture & animal husbandry, pharmaceutical industry and environment & Energy sectors. Hazards of environmental engineering - Biosafety and bioethics.

**References:**

1. Dubey R.C., 2001. A text book of Biotechnology 1st Edition. S.Chand & Company Ltd., New Delhi. Pg. 43-80; 113-197; 331-391.
2. Chhatoval G.R., 1995. Text book of Biotechnology, 1st Edi, Anmol Publications Pvt. Ltd., New Delhi.
3. Glick, B.R. and Pasternak, J.J 1994. Molecular Biotechnology, ASM Press, Washington DC.
4. Demain, A.L., Solomon, N.A. 1986. "Manual of Industrial Microbiology and Biotechnology", ASM Press, Washington.
5. Sambrook J, Fritsch E. F. and Maniatis (1989) Molecular cloning, vol. I, II, III, II nd edition, Cold spring harbor laboratory press, New York.
6. DNA Cloning : A practical approach D.M. Glover and D.B. Hames, RL Press, Oxford, 1995
7. P.B. Kaufman, W. Wu , D. Kim and L.J. Cseke, 1995. Molecular and cellular methods in Biology and Medicine, CRC Press Florida
8. Berger and A. R. Kimmel, 1996. Methods in Enzymology Guide to Molecular Cloning Techniques, Vol. 152 S.L. Academic Press Inc, San Diego,
9. D. A. Mickloss and G. A Freye 1990. Methods in Enzymology Gene Expression Technology, Vol. 185D. V. Goedel, Academic Press Inc, San Diego,
- 10.. S. B. Primrose 1994. Molecular Biotechnology, 2nd Ed., Blackwell Scientific publishers, Oxford,

**Web resources:**

<http://microbiology.ucsc.edu>

<http://www.asm.org>

21MIBR0103	<b>SPECIALIZATION COURSE</b>	<b>CREDITS: 4</b>
** Detailed Syllabus for Area of Specialization will be prepared by the respective Doctoral Committee.		

**Objectives:**

- To learn about nature, scope, and concept of philosophy and ethics
- To learn about scientific conduct and publication ethics
- To learn open access publishing, Misconduct, Databases and Research Metrics

**Learning Outcomes**

On completion of the course, the scholars should be able to

- Understand the scope and concepts in philosophy and ethics
- Recognize the scientific misconducts
- Realize the importance of publication ethics
- Understand open access publication
- Create awareness on the importance of scientific data bases and research matrices

**Unit I Philosophy and Ethics**

Introduction to philosophy: Definition, nature and scope, concept, branches. Ethics: Definition, moral philosophy, nature of moral judgements and reactions.

**Unit II Scientific conduct**

Ethics with respect to science and research- Intellectual honesty and research integrity- Scientific misconducts: Falsification, fabrication, and Plagiarism (FFP) – Redundant publications: duplicate and overlapping publications, salami slicing – Selective reporting and misrepresentation of data

**Unit III Publication Ethics**

Publication ethics: Definition, introduction and importance- Best practices/standards setting initiatives and guidelines: COPE, WAME, etc- Conflicts of interest- Publication misconduct: Definition, concept, problems that lead to unethical behaviour and vice versa, types- Violation of publication ethics, authorship and contributorship – Identification of publication misconduct, complaints and appeals- Predatory publishers and journals

**Unit IV Open Access Publishing**

Open access publications and initiatives-SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies- Software tool to identify predatory publications developed by SPPU -Journal finder/ journal suggestion tools viz. JANE, Elsevier Finder, Springer Journal Suggester, etc

## Unit V Publication Misconduct, Databases and Research Metrics

Subject specific ethical issues, FFP, authorship- Conflicts of interest-Complains and appeals: examples and fraud from India and abroad- Use of plagiarism software like Turnitin, Urkund and other open source software tools. Databases-Indexing databases-Citation databases: Web of Science, Scopus etc- Impact factor of journal as per Journal Citation Report, SNIP, SJR,IPP,Cite Score- Metrics: h-index,i10 index, almetrics.

### References

1. Bird,A.2006. Philosophy of Science.Routledge.
2. Indian National Sciency Academy(INSA)2019 . Ethics in Science Education, Research and Governance.ISBN:978-81-939482.1- 7.  
[http://www.insaindia.res.in/pdf/Ethics\\_Book.pdf](http://www.insaindia.res.in/pdf/Ethics_Book.pdf)
3. Chaddah,P 2018 Ethics in Competitive Research: Do not get scooped; do not get plagiarized,ISBN:978-9387480865.
4. Beall,J.2012.Predatory publishers are corrupting open access.Nature,4089(7415),179.<https://doi.org/10.1038/48917a>
5. Resnik,D.B.2011.What is ethics in research & Why is it important.National Institute of Environmental Health Sciences,1-10.Retrieved from <https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm>
6. National Academy of Sciences,National Academy of Engineering and Institute of Medicine.2009.On being a Scientist: A Guide to Responsible Conduct in Research: Third Edition. National Academy Press
7. MacIntyre,Alasdair.1967.A Short History of Ethics.London