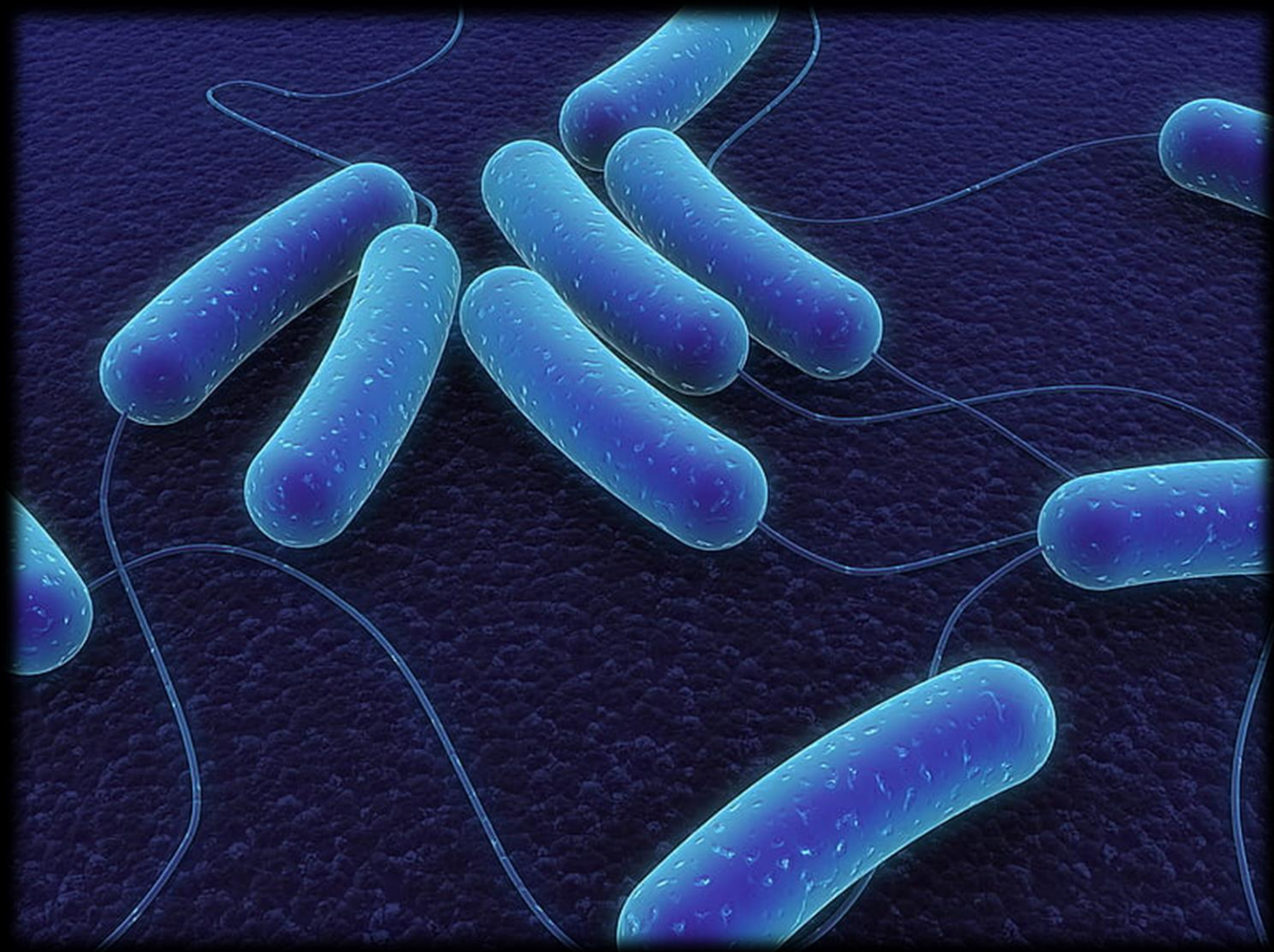


P. Saranraj

Medical Bacteriology



First Edition



JPS, Scientific Publications, India

Textbook

MEDICAL BACTERIOLOGY

Editor

Dr. P. Saranraj

*Head, Department of Microbiology, Sacred Heart College (Autonomous),
Tirupattur, Tamil Nadu, India.*

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India**

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ABOUT THE EDITOR – Dr. P. Saranraj

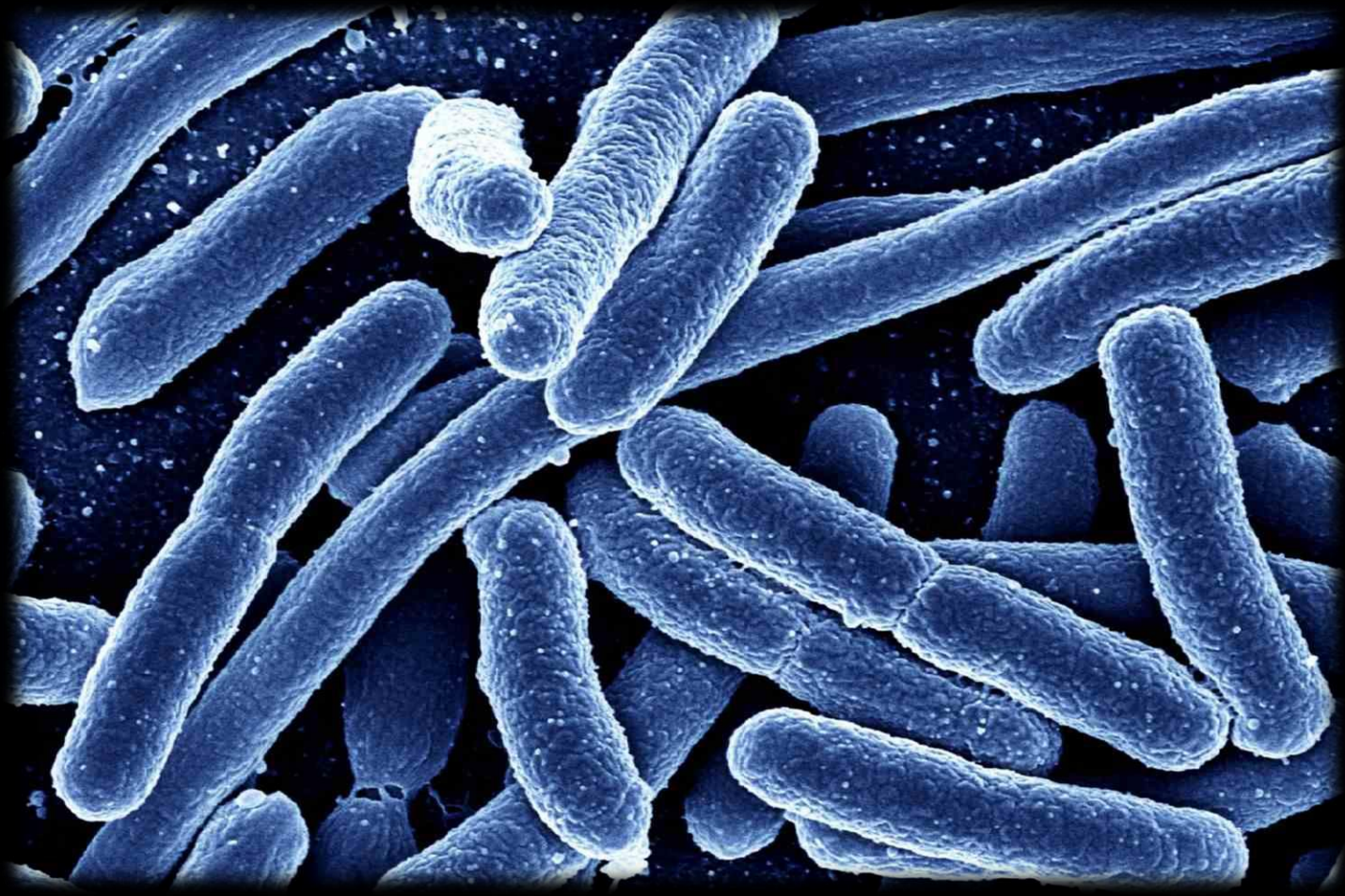


Dr. P. Saranraj is presently an Assistant Professor and Head at the Department of Microbiology, Sacred Heart College (Autonomous), Tirupattur, Tamil Nadu, India. Prior to this he has worked as a Senior Research Fellow in Department of Microbiology, Annamalai University for 3 years. He is having teaching experience of 9 years and he has guided 14 M.Sc students for their project. He has been involved with teaching and research in area of Microbiology. He received his Ph.D Microbiology degree from Annamalai University in 2013 and he was qualified in NET exam in 2017. He has published 185 papers (Citations - 4250, H - index: 38 and i10 index - 81) in peer reviewed International Journals, 60 Books and 30 Book chapters. He is an Editorial Board Member and Reviewer of 30 International Journals. And he has also involved himself in filing an International Innovation Patent granted by the Government of Australia (AusPat) for his research team's innovation on Silver Nanoparticles. He has deposited 6 Bacterial Sequence in NCBI and received the Accession Number. He was also conferred with awards like Best Review Paper Award (2011), Young Scientist Award (2013), Best Research Forum Coordinator Award (2017), Highest Book Publication Award (2017), Best Review Paper Award (2017), Highest Research Paper Publication Award (2018), Young Researcher Award (2018), Best Research Forum Coordinator Award (2019), Indian Microbiologists Society Young Scientist Award (2019), Highest Citations Award (2019), Best Research Forum Coordinator Award (2020), Research Excellence Award (2020), Young Academic Achiever Award (2020) and Microbiology Young Scientist Award (2021). According to AD Scientific Index World Scientist Ranking (Microbiology), his name was placed in 28th Rank in India Level, 111th Rank in Asia Level and 801th Rank in World. He is a life member in various organizations *viz.*, Microbiologists Association, India and Asian PGPR Society.

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- 3) Old, R. S and S. B. Primrose. 2006. Principles of Gene Manipulation, 7th Edition, Blackwell Scientific Publications, London.

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- 1) Gardner, E. J., M. J. Simmons and D. P. Snustad. 2005. Principles of Genetics, 8th Edition, John Wiley and Sons, New York.
- 2) Klug, W. S and M. R. Cummings. 2001. Essentials of Genetics, 4th Edition, Prentice Hall, New Jersey.
- 3) Chatterjee, N and Rana Shinde. 2012. Textbook of Medical Biochemistry, 8th Edition, Jaypee publication, New Delhi, India.
- 4) Weaver, R. F. 2008. Molecular Biology, 5th Edition, McGraw Hill, New York.

Semester – V
5 Hours
5 Credits

MEDICAL BACTERIOLOGY

Objectives

- To make the students to understand the Medical Bacteriology.
- To learn the methods of Clinical sample collection and its transport.
- To gain knowledge on Diagnostics methods for Bacterial identification.
- To study the pathogenicity, clinical symptoms and treatment for disease causing bacteria.
- To provide the ability to characterize, isolate and identify different Medically important bacteria.

Course Outcomes

To introduce the knowledge of the medically important bacteria, bacterial morphology with the main focuses being the pathogenicity, clinical symptoms, identification and treatment for different bacteria.

S.No.	Description	Cognitive Level (K-Level)
CO-1	Introducing the knowledge of the Medically important bacteria.	K3
CO-2	Acquire the skill of sample collection, transport and processing for bacterial identification.	K4
CO-3	Describe the bacterial morphology with the main focuses being the pathogenicity, clinical symptoms, identification and treatment for different bacteria.	K1
CO-4	Create an awareness on bacterial diseases and classification for diagnosing Gram positive bacteria and spore formers.	K6
CO-5	Evaluate the implications of Mycobacterial diseases and drug resistance in the society.	K5
CO-6	Detect the etiology and virulence factors of Gram negative bacterial diseases, interpreting the laboratory results after following standard operating procedures.	K2

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)									Mean Scores of COs
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PS O1	PS O2	PS O3	PS O4	PS O5	PS O6	PS O7	PS O8	PS O9	
1	3	3	2	2	3	3	3	3	3	3	2	3	3	3	2	3	2.7
2	2	2	3	3	2	3	1	2	3	2	3	3	2	2	3	2	2.3
3	3	1	2	3	1	3	3	3	2	3	2	2	3	3	2	3	2.4
4	2	2	3	2	3	2	2	2	3	3	3	3	3	3	3	2	2.5
5	2	3	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2.1
6	3	2	2	3	3	2	3	3	2	3	3	3	3	3	2	3	2.6
Mean Overall Score																2.5	
Result																High	

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	10
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	20

Unit - I

Clinical Specimens - Collection, Transport and Storage; Epidemiology of Microbial infections; Laboratory diagnosis of Bacteria – Staining techniques, Culture medium, Biochemical tests and Serological tests; Antibiotics – Microorganisms involved in Antibiotics production, Spectrum of activity of Antibiotics; Classification, Antibiotic Sensitivity Test and Antimicrobial Resistance.

Unit – II

Morphology, Cultural characteristics, Pathogenicity, Clinical Syndrome, Laboratory diagnosis, Treatment and Preventive measures for Gram Positive Cocci - *Staphylococcus aureus*, *Streptococcus pyogenes*, *Streptococcus agalactiae*, Viridans *Streptococci* (*Streptococcus pneumoniae*) and Gram Negative Cocci – *Neisseria meningitidis* and *Neisseria gonorrhoeae*.

Unit – III

Morphology, Cultural characteristics, Pathogenicity, Clinical Syndrome, Laboratory diagnosis, Treatment and Preventive measures for Gram Positive Bacilli - *Bacillus anthracis*, *Bacillus cereus*, *Clostridium* sp., *Listeria monocytogenes*, *Corynebacterium diphtheriae*, *Mycobacterium leprae* and *Mycobacterium tuberculosis*).

Unit – IV

Morphology, Cultural characteristics, Pathogenicity, Clinical Syndrome, Laboratory diagnosis, Treatment and Preventive measures for Enterobacteriaceae (*Escherichia coli*, *Klebsiella pneumoniae*, *Proteus* sp., *Salmonella* sp. and *Shigella* sp.), *Pseudomonas aeruginosa*, *Vibrio cholerae*, *Campylobacter jejuni* and *Helicobacter pylori*.

Unit – V

Morphology, Cultural characteristics, Pathogenicity, Laboratory diagnosis, Treatment and Preventive measures for *Haemophilus influenzae*, *Brucella* sp., *Bordetella* sp. Spirochaetes (*Treponema pallidum*, *Borrelia* sp. and *Leptospira* sp.), *Mycoplasma* sp. and *Rickettsia* sp. Current Research Thoughts in Medical Bacteriology.

Text Books

- 1) Jawetz, E., J. L. Melnic and E. A. Adelberg. 2013. Review of Medical Microbiology, 26th Edition, Lange Medical Publishers, New York.
- 2) Patrick Murray, Ken Rosenthal and Michael Pfaller. 2016. Medical Microbiology, 8th Edition, Elsevier Publications, United States.
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- 1) Joanne M. Willey, Linda M. Sherwood and Christopher J. Woolverton. 2017. Prescott's Microbiology, 10th Edition, McGraw Hill Publication, United States.
- 2) Reba Kanungo. 2017. Ananthanarayan and Paniker's Text book of Microbiology, 7th Edition, Orient Longman Limited, Chennai, India.
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- 4) Baron, E. J and S. M. Finegold. 1990. Bailey and Scott's Diagnostic Microbiology, 8th Edition, The C.V. Mosby Company. St. Louis, Missouri.

Semester – V
5 Hours
5 Credits

MEDICAL VIROLOGY**Objectives**

- To make the students to understand the role of viruses in major diseases.
- To provide the knowledge on general characters and classification of viruses.
- To teach the structure, cultivation and various strategies of Virus replication.
- To gain knowledge on Antiviral drugs, Vaccines and Vaccination.
- To study general aspects of Structure, Classification, Replication, Pathogenicity, Clinical Syndrome, Laboratory diagnosis, Treatment and Preventive measures for Viruses.

Course Outcomes

Virologist are highly demanded in the Medical research companies, Pharmaceutical companies, Governmental agencies, Laboratory testing companies or Cancer treatment or Research companies depending upon the specialization. This paper will provide the wide knowledge on Structure, Classification, Replication, Pathogenicity, Clinical Syndrome, Laboratory diagnosis, Treatment and Preventive measures for Viruses.

Course Outcome (CO)	Description	Cognitive Level (K-Level)
CO-1	Recognize characters of different types of viruses.	K1
CO-2	Compare the complex interaction between viruses and host cells.	K2
CO-3	Analyze and teach newer emerging viral infections including the viral mutant forms for emerging.	K3, K4
CO-4	Outline the basics and essential concepts of Virology.	K4
CO-5	Evaluate and discuss the structure, classification, pathogenesis, replication, purification and disease control.	K5, K6

plants, animals and humans; Fungi as Biocontrol agent and Bioinsecticide; Mycotoxins and its types; Current Research Thoughts in Phycology and Mycology.

Text Books

- 1) Hoek, C., Mann, D. G and Jahns, H. M. 1995. Algae - An introduction to Phycology, 39; Cambridge University Press.
- 2) Stephen, J. O. 1993. Bacteria, Algae, and Protozoa - Cold Spring Harbor Laboratory Press.
- 3) Sarabhai, B. P and Arora, C. K. 2005. Textbook of Algae. Anmol Publishing Pvt. Ltd. New Delhi.
- 4) Sharma, O. P. 2001. Textbook of Algae. Tata McGraw Hill Company, New Delhi.
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- 1) Khan, M. 1970. Algae today, Gajendra Singh Gahlot at Siva Printers, Dehra Dun, India.
- 2) Amrik, S. A. 2003. Phycology: Principles, processes and applications. Daya Publishing House, Delhi.
- 3) Rajarao, V. N. 1990. Perspectives in Phycology, Today and Tomorrow Printers and publishers, New Delhi.
- 4) Steve, P. 2009. Protozoans, Algae & Other Protists - Capstone Press.

Semester – II

6 Hours/4 Credits

MEDICAL BACTERIOLOGY

Objectives

- To impart in-depth understanding of normal flora and its importance, learn bacterial classification and virulence factors contributing to pathogenicity.
- To provide insights into processing of samples and laboratory diagnosis of pathogenic bacteria.
- To illustrate methods involved in collection and transport of samples and its biosafety guidelines for bacterial identification.
- To teach various cultivation methods, pathogenesis and clinical features of bacteria affecting humans.
- To provide the ability to characterize, isolate and identify different Medically important bacteria.

Course Outcomes

Course Outcome (CO)	Description	Cognitive Level (K-Level)
CO-1	Introducing the knowledge of the Medically important bacteria.	K3
CO-2	Differentiate normal flora from pathogens, analyse the factors contributing to pathogenicity and acquire the skill of sample collection, transport and processing for bacterial identification.	K2, K3, K4
CO-3	Describe the morphology with the focuses being the pathogenicity, symptoms, identification and treatment for different bacteria.	K1

CO-4	Analyse and create an awareness on bacterial diseases and classification for diagnosing Gram positive bacteria and spore formers.	K3, K6
CO-5	Evaluate the implications of Mycobacterial diseases and drug resistance in the society.	K5
CO-6	Detect the etiology and virulence factors of Gram negative bacterial diseases, interpreting the laboratory results after following standard operating procedures.	K2

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)										Mean Scores of COs
	PO 1	PO 2	PO 3	PO 4	PO 5	PS O1	PS O2	PS O3	PS O4	PS O5	PS O6	PS O7	PS O8	PS O9	PSO 10	
1	3	3	2	2	3	3	3	3	2	3	3	3	2	3	3	2.7
2	2	2	3	3	2	2	3	2	3	3	2	2	3	2	1	2.3
3	3	1	2	3	1	3	2	3	2	2	3	3	2	3	3	2.4
4	2	2	3	2	3	2	3	3	3	3	3	3	3	2	2	2.6
5	2	3	3	2	2	2	2	2	2	2	2	2	3	2	2	2.2
6	3	2	2	3	3	3	2	3	3	3	3	3	2	3	3	2.7
Mean Overall Score															2.5	
Result															High	

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	10
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	20

Unit - I

Normal microbial flora of human body; Microbial Infection – Types, Source, Transmission and Factors predisposing to Microbial Pathogenicity; Epidemiology of Microbial infections; Clinical Specimens - Collection, Transport and Storage; Laboratory diagnosis of Bacteria – Staining techniques, Culture medium, Biochemical tests and Serological tests; Antibiotics – Microorganisms involved in Antibiotics production, Spectrum of activity of Antibiotics; Classification based on mode of action, Antibiotic Sensitivity Test and Antimicrobial Resistance.

Unit – II

Morphology, Cultural characteristics, Pathogenicity, Clinical Syndrome, Laboratory diagnosis, Treatment and Preventive measures for Gram Positive Cocci - *Staphylococcus aureus*, Coagulase negative *Staphylococcus* sp., *Streptococcus pyogenes*, *Streptococcus agalactiae*, Viridans *Streptococci* (*Streptococcus pneumoniae*), *Enterococcus* sp. and Gram Negative Cocci – *Neisseria meningitidis* and *Neisseria gonorrhoeae*.

Unit – III

Morphology, Cultural characteristics, Pathogenicity, Clinical Syndrome, Laboratory diagnosis, Treatment and Preventive measures for Gram Positive Bacilli - *Bacillus anthracis*, *Bacillus cereus*, *Clostridium tetani*, *Clostridium perfringens*, *Clostridium botulinum*, *Clostridium difficile*, *Listeria monocytogenes*, *Erysipelothrix rhusiopathiae*, *Corynebacterium*

diphtheriae, *Nocardia brasiliensis*, *Mycobacterium leprae*, *Mycobacterium tuberculosis* and *Mycobacterium avium* Complex.

Unit – IV

Morphology, Cultural characteristics, Pathogenicity, Clinical Syndrome, Laboratory diagnosis, Treatment and Preventive measures for Enterobacteriaceae (*Escherichia coli*, *Klebsiella pneumoniae*, *Proteus* sp., *Salmonella* sp., *Shigella* sp., *Serratia marcescens* and *Yersinia pestis*), *Pseudomonas aeruginosa*, *Vibrio cholerae*, *Aeromonas hydrophila*, *Campylobacter jejuni* and *Helicobacter pylori*.

Unit – V

Morphology, Cultural characteristics, Pathogenicity, Laboratory diagnosis, Treatment and Preventive measures for *Haemophilus influenzae*, *Pasteurella multocida*, *Propionibacterium acne*, *Francisella tularensis*, *Brucella* sp., *Bordetella pertussis*, *Legionella pneumophila*, Spirochaetes (*Treponema pallidum*, *Borrelia* sp. and *Leptospira* sp.), *Mycoplasma* sp., *Rickettsia* sp. and *Chlamydia trachomatis*; Current Research Thoughts in Medical Bacteriology.

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Semester – II

5 Hours/4 Credits

MEDICAL VIROLOGY

Objectives

- To make the students to understand the role of viruses in major diseases.
- To provide the knowledge on general characters and classification of viruses.
- To teach the structure, cultivation and various strategies of Virus replication.
- To impart knowledge regarding the diagnostics, clinical aspects and related implications of human viral diseases and emerging viral infections.

Textbook of
MICROBIAL INOCULANTS
TECHNOLOGY



First Edition

P. Saranraj
P. Sivasakthivelan



Textbook

Textbook of MICROBIAL INOCULANTS TECHNOLOGY

Editor

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ABOUT THE EDITOR - Dr. P. Saranraj



Dr. P. Saranraj is presently an Assistant Professor and Head at the Department of Microbiology, Sacred Heart College (Autonomous), Tirupattur, Tamil Nadu, India. Prior to this he has worked as a Senior Research Fellow in Department of Microbiology, Annamalai University for 3 years. He is having teaching experience of 9 years and he has guided 14 M.Sc students for their project. He has been involved with teaching and research in area of Microbiology. He received his Ph.D Microbiology degree from Annamalai University in 2013 and he was qualified in NET exam in 2017. He has published 185 papers (Citations - 4250, H - index: 38 and i10 index - 81) in peer reviewed International Journals, 60 Books and 30 Book chapters. He is an Editorial Board Member and Reviewer of 30 International Journals. And he has also involved himself in filing an International Innovation Patent granted by the Government of Australia (AusPat) for his research team's innovation on Silver Nanoparticles. He has deposited 6 Bacterial Sequence in NCBI and received the Accession Number. He was also conferred with awards like Best Review Paper Award (2011), Young Scientist Award (2013), Best Research Forum Coordinator Award (2017), Highest Book Publication Award (2017), Best Review Paper Award (2017), Highest Research Paper Publication Award (2018), Young Researcher Award (2018), Best Research Forum Coordinator Award (2019), Indian Microbiologists Society Young Scientist Award (2019), Highest Citations Award (2019), Best Research Forum Coordinator Award (2020), Research Excellence Award (2020), Young Academic Achiever Award (2020) and Microbiology Young Scientist Award (2021). According to AD Scientific Index World Scientist Ranking (Microbiology), his name was placed in 28th Rank in India Level, 111th Rank in Asia Level and 801th Rank in World. He is a life member in various organizations *viz.*, Microbiologists Association, India and Asian PGPR Society.

ABOUT THE EDITOR - Dr. P. Sivasakthivelan



Dr. P. Sivasakthivelan is currently working as an Assistant Professor in the Department of Agricultural Microbiology at the Faculty of Agriculture, and also serving as the Associating Scientist at the Centre for Natural Farming and Sustainable Agriculture (CNFSA), Annamalai University, Tamil Nadu. He is the Deputy Chairman of National Agricultural Education Cell (NAEC) - AIASA, New Delhi. He was recipient of 4 gold medal for his outstanding academic performance at University level viz., Srilochani Varadaarajalu medal, Prof.G.Rangaswami medal, Shri. M.P.Damodaran Agricultural medal and Jawaharlal Nehru memorial merit fund award. He has a teaching experience of 16 years handling UG, PG, and Doctoral Degree Programmes in Agricultural Microbiology. He has visited countries like Singapore, Malaysia, and Sri Lanka for upgrading and disseminating knowledge. He has presented papers in 20 International and 63 National Conferences. He has delivered 27 invited lectures in various institutions across the state. He has participated in 28 National level workshops and 18 National Training programs including training at National Institute of Agricultural Extension Management (MANAGE), Hyderabad, and Indian Institute of Management (IIM), Lucknow. He has Authored 3 books, and 10 book chapters at Elsevier, CRC Press, Taylor and Francis Group, London. To his credit, he has 70 research publications in reputed peer-reviewed international journals with the Google Scholar Citation of 524, h - index of 13 and i10 - Index of 16. He has guided 16 Research scholars in PG and guiding 2 scholar in Ph.D. Program. And he is currently operating a research project funded by Tamil Nadu State Council for Science and Technology (TNSCST) with an outlay of 3.80 Lakhs, and serving as Co-Principal investigator of Tamil Nadu State Council for Higher Education (TANSCHHE) Sponsored research project with an outlay of 48.56 lakhs. His area of research is the formulation of bio inoculants with low-cost carriers and the development of an agriculturally beneficial microbial consortium. He is a life member in various organizations viz., Association of Microbiologists of India (AMI), Indian Association of Applied Microbiologist (IAAM), Agricultural Scientific Tamil Society (SciTSA) New Delhi, Indian Science Congress Association (ISCA), and Asian PGPR Society for Sustainable Agriculture (APSSA). He has also served as the Associating scientist of the World Bank-funded ICAR- NAIP research project with a total project outlay of 09.33 crores.

He is also a Panel member to interact with the delegates of Rice Focal Point Experts of SAARC countries during their Exposure visit to Annamalai University. He is presently serving as a Team member in the Memorandum of Understanding Signed between Annamalai University and International Rice Research Institute (IRRI), Philippines to evaluate 108 rice lines on the “Multiple stress-tolerant rice varieties suitable for Tamil Nadu”. As a part of this MoU to his credit, he has also served as one of the scientists in the release of the Rice Variety AU - 1 GSR in collaboration with IRRI. And he has also involved himself in filing an International Innovation patent granted by the Government of Australia (AusPat) Patent Number: (2021100276) for his research teams innovation on “Low-Density Polyethelene (LDPE) degradation process”.

He was also conferred with the Rajapuraskar Scout Award (2000) by the Governor of Tamil Nadu and with the Rashtrapathi Scout Award (2002) by the President of India.

He has also been elected as the Associate Fellow of Society for Nature and Applied Sciences -AFSNAS and Fellow Bose Science Society - FBSS by Tamil Nadu Scientific Research Organisation (TNSRO). And he is also a recipient of the Young Scientist Award - 2017 instituted by the Indian Association of Applied Microbiology, “Outstanding Faculty Award - 2018” by Arunai International Research Foundation, “Young Scientist Award - 2019” for the outstanding contribution in the field of Food Science and Technology at 2nd International Conference and Expo on Food and Nutrition held at Kuala Lumpur, Malaysia. “Best Scientist Award - 2020” by Nature Science Foundation, Coimbatore for the outstanding contribution in the field of Agricultural Microbiology. “Best Young Scientist Award” by PEARL Foundation Educational Excellence Awards in Higher education in India 2020 and he was also Conferred with “Best Technical Consultant Award - 2020” by Agri Sakthi Agricultural Magazine during the Second commemoration Day of the Magazine on 15th May 2021.

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Semester – IV
4 Hours
4 Credits

BIOINOCULANT TECHNOLOGY

Objectives

- To study about the Formulation, Application and Quality control of Bioinoculants.
- To understand the role of Nitrogen fixers and Phosphate solubilizers in Agriculture.
- AM fungi and Algal biofertilizers.
- To learn the ability of Biocontrol agents to control the Plant pathogens.
- To gain the knowledge of Entomopathogens for the control of Insect pests.

Course Outcomes

The course Bioinoculant Technology has been designed to provide the knowledge to the students about Natural organic farming. This paper also provides the details of Production, Formulation, Method of application and Quality control of Bioinoculants.

Course Outcome (CO)	Description	Cognitive level (K level)
CO-1	Acquire knowledge on Microbial inoculants.	K3
CO-2	Gives the knowledge to the students about Production and Formulation of Bioinoculants.	K1, K3
CO-3	Explains the details on Method of application and Quality control of Bioinoculants.	K2
CO-4	Analyzing the Symbiotic relationship between Plant and Mycorrhizal fungi.	K4
CO-5	Developing different methods for the Pest control using microbes.	K6
CO-6	Recommending the factors for good Soil quality and Agricultural output through sustainable Microbiological applications.	K5

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)									Mean Scores of COs
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PS O1	PS O2	PS O3	PS O4	PS O5	PS O6	PS O7	PS O8	PS O9	
1	3	2	2	3	2	2	2	2	3	3	3	3	2	3	3	2	2.5
2	3	2	2	3	3	2	3	2	3	2	3	3	2	2	3	2	2.5
3	2	2	2	3	2	2	3	3	1	2	3	2	3	2	2	3	2.3
4	2	2	3	3	2	2	3	2	3	2	3	3	2	2	3	2	2.4
5	2	2	3	2	3	3	2	2	2	1	2	2	2	2	2	2	2.1
6	3	3	2	2	3	3	2	3	2	2	3	3	3	2	2	3	2.5
Mean Overall Score																2.4	
Result																High	

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	10
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	20

Unit – I

Bioinoculants – Definition, Types and Importance; Advantages of Biofertilizers over Chemical fertilizers; Formulations of Bioinoculants; Methods and application of Bioinoculants in different crops; Quality control of different Bioinoculants; Plant – Microbe Interaction.

Unit – II

PGPR and its role in agriculture – Direct mechanism and Indirect mechanism; Nitrogen fixation by bacteria; Isolation, Characterization (Microscopic, Cultural and Biochemical), Mass multiplication and Field application of Nitrogen fixing bacteria (*Rhizobium* sp., *Frankia* sp., *Azotobacter* sp., *Azospirillum* sp. and *Gluconacetobacter* sp.).

Unit – III

Phosphate solubilization – Phosphate solubilizing microorganisms, Mechanism of Phosphate solubilization and Screening of Phosphate solubilizing efficiency; Algal Biofertilizers – Isolation and Mass multiplication of Blue Green Algae, Mass multiplication of *Azolla*, *Azolla* – *Anabaena* symbiosis, Heterocyst and its importance in N₂ fixation.

Unit – IV

Mycorrhizal Bioinoculants – Significance, Types and Benefits; Arbuscular Mycorrhiza (AM) fungi – Taxonomy of AM fungi, Isolation of AM fungi, Assessment of AM colonization in roots, Culturing of AM fungi, Mass inoculum production, Field applications; Role of AM fungi in agriculture.

Unit – V

Host-parasite relationship in plants; Plant disease control agents (*Bacillus subtilis*, *Pseudomonas fluorescens* & *Trichoderma* sp.); Biopesticides – Entomopathogenic bacteria (*Bacillus thuringiensis*); Entomopathogenic fungi (*Beauveria bassiana*, *Isaria fumosorosea*, *Lecanicillium* sp. & *Metarhizium anisopliae*); Entomopathogenic virus (Cydia pomonella granulosis virus - CpGv); Current Research Thoughts in Bioinoculant Technology.

Text Books

- 1) Vijaya Ramesh, K. 2008. Environmental Microbiology, MJP Publishers, Chennai, India.
- 2) Subba Rao N.S. 1999. Soil Microbiology, 4th Edition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, India.
- 3) Saranraj, P and P. Sivasakthivelan. 2020. Textbook of Microbial Inoculants Technology. JPS Scientific Publications, India.

References

- 1) Joanne M. Willey, Linda M. Sherwood and Christopher J. Woolverton. 2017. Prescott's Microbiology, 10th Edition, McGraw Hill Publication, United States.
- 2) Atlas, R.M and R. Bartha. 1998. Microbial Ecology. Fundamentals and Applications, 4th Edition, Red Wood City. C.A. Benjamin.
- 3) Bagyaraj, D. J and G. Rangasamy. 2002. Agricultural Microbiology, 2nd Edition, Prentice Hall, India.
- 4) Mahendra K. Rai. 2005. Hand book of Microbial Biofertilizers, The Haworth Press, Inc. New York.

Monitoring Animal activity, Food, Bedding and Water; Sanitation, Cleanliness and Waste disposal in Animal house; Record keeping in Animal house; Standard Operating Procedures for Animal Husbandry; Transport of Laboratory Animals; Anesthesia and Euthanasia.

Unit – V

Composition of Institutional Ethical Committee (IEC) - General Ethical Issues, Laboratory Animal Ethics, Food and Drug safety Ethics; Ethical issues in Human Gene Therapy and Human Cloning; Environmental release of Genetically Engineered Microorganisms; Intellectual Property Rights (IPR) – Protection of IPR in India, Terminology Associated with IPR and Issues Relating to IPR; Patentable and Non – patentables; World Intellectual Property Rights Organization (WIPO); Research funding agencies in India.

Text Books

- 1) Gurumani, N. 2004. Research Methodology for Biological Sciences. MJP Publishers, India.
- 2) Anderson, J. B and M. Poole. 2011. Assignment and Thesis Writing. 4th Edition, Wiley India Private Limited, UK.
- 3) Kothari, C. R and G. Garg. 2004. Research Methodology: Methods and Techniques. 2nd edition, New Age International Publishers, India.
- 4) Sateesh, M. K. 2008. Bioethics and Biosafety. I. K. International Pvt. Ltd, New Delhi, India.

References

- 1) Gupta, S. P. 2013. Fundamentals of Statistics, Sultan Chand, India.
- 2) Goel, D and S. Parashar. 2013. IPR, Biosafety and Bioethics. Pearson Education in South Asia.
- 3) Ethical guidelines for biomedical research on human subjects. ICMR, New Delhi, 2000.
- 4) Ahuja, V. K. 2017. Laws Relating to Intellectual Property Rights. Lexis Nexis.

Semester – III**4 Hours/4 Credits**

BIOINOCULANT TECHNOLOGY AND PLANT PATHOLOGY

Objectives

- To study about the Production, Formulation, Method of application and Quality control of Bioinoculants.
- To create an awareness on Soil microorganisms in Agriculture.
- To understand the role of Nitrogen fixers, Phosphate solubilizers, AM fungi and Algal biofertilizers.
- To give knowledge on Plant pathogen interaction and its control.
- To learn the ability of Biopesticides and Biocontrol agents in Plant growth.

Course Outcomes

Course Outcome (CO)	Description	Cognitive level (K level)
CO-1	Acquire knowledge on Bioinoculant technology.	K3
CO-2	Gives the knowledge to the students about Natural organic farming.	K1, K3
CO-3	Explains the details of Production, Formulation, Method of application and Quality control of Bioinoculants.	K2
CO-4	Analyzing the diseases causing ability of microorganisms in plants and its control measures.	K4
CO-5	Developing different methods for the Pest control using microbes.	K6
CO-6	Recommending the factors for good Soil quality and Agricultural output through sustainable Microbiological applications.	K5

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)										Mean Scores of COs
	PO 1	PO 2	PO 3	PO 4	PO 5	PS O1	PS O2	PS O3	PS O4	PS O5	PS O6	PS O7	PS O8	PS O9	PSO 10	
1	3	2	2	3	2	2	2	2	3	3	3	3	2	3	3	2.5
2	3	2	2	3	3	2	3	2	3	2	3	3	2	2	3	2.5
3	2	2	2	3	2	2	3	3	1	2	3	2	3	2	2	2.2
4	2	2	3	3	2	2	3	2	3	2	3	3	2	2	3	2.4
5	2	2	3	2	3	3	2	2	2	1	2	2	2	2	2	2.1
6	3	3	2	2	3	3	2	3	2	2	3	3	3	2	2	2.5
Mean Overall Score															2.4	
Result															High	

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	10
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	20

Unit – I

Bioinoculants – Definition, Types and Importance; Advantages of Biofertilizers over Chemical fertilizers; Formulations of Bioinoculants; Methods and application of Bioinoculants in different crops; Quality control of different Bioinoculants; Plant – Microbe Interaction; PGPR and its role in agriculture – Direct mechanism and Indirect mechanism; Role of PGPR in Soil Bioremediation.

Unit – II

Nitrogen fixation by bacteria; Isolation, Characterization, Mass multiplication, Field application and Plant growth promoting activities of Nitrogen fixing bacteria (*Rhizobium* sp., *Frankia* sp., *Azotobacter* sp., *Azospirillum* sp. and *Gluconacetobacter* sp.). Phosphate solubilization – Phosphate solubilizing microorganisms, Screening of Phosphate solubilizing efficiency, Mechanism of Phosphate solubilization and Benefits of Phosphate solubilizing microorganisms; Algal Biofertilizers – Isolation and Mass multiplication of Blue Green Algae (BGA), Mass multiplication of *Azolla*, *Azolla* – *Anabaena* symbiosis, Heterocyst and its importance in N₂ fixation.

Unit – III

Mycorrhizal Bioinoculants – Significance, Types and Benefits; Arbuscular Mycorrhiza (AM) fungi – Taxonomy, Isolation, Assessment of AM colonization in roots, Mass inoculum production, Field applications; AM fungi and Abiotic stress; Role of AM fungi in agriculture; Biopesticides – Entomopathogenic bacteria (*Bacillus thuringiensis*); Entomopathogenic fungi (*Beauveria bassiana*, *Verticillium lecanii*, *Isaria fumosorosea*, *Lecanicillium* sp. & *Metarhizium anisopliae*); Entomopathogenic virus (Cydia pomonella granulosis virus - CpGv); Plant disease control agents (*Bacillus subtilis*, *Bacillus megaterium*, *Pseudomonas fluorescens* & *Trichoderma viride*).

Unit – IV

History of Plant Pathology; Host-parasite relationship in plants; Principles of Plant diseases; Plant Disease Triangle; Plant diseases - Symptoms and Types; Pathogenic and Non-pathogenic Plant diseases; Plant Pathology in Practice - Plant Clinic and Plant Doctor Concept; Biochemical aspects of disease development; Principle of Biotrophic, Hemibiotrophic and Perthotrophic colonization; Molecular detection of Phytopathogens.

Unit – V

Antibiosis and Biological control of Soil borne plant pathogens; Microbial pest management; Mycotoxins in plants; List of important Plant diseases; Bacterial diseases – Blight of rice, Citrus canker & Wilt of potato; Fungal diseases – Blast of rice, Late blight of potato, Rust of wheat, Smut of sugar cane, Wilt of cotton, Tikka leaf spot of ground nut, Mildews of fruits, Leaf curl disease & Little leaf disease; Viral diseases - Mosaic disease; Disease Resistance - Biochemical and Genetic aspects; Defense mechanism in Plants; Current Research Thoughts in Bioinoculant Technology and Plant Pathology.

Text Books

- 1) Saranraj, P and Sivasakthivelan, P. 2020. Text Book of Bioinoculants Technology. 1st Edition, JPS Scientific Publications, India.
- 2) Vijaya Ramesh, K. 2008. Environmental Microbiology, MJP Publishers, Chennai, India.
- 3) Subba Rao N.S. 1999. Soil Microbiology, 4th Edition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, India.
- 4) Mehrotra, R. S. 1983. Plant Pathology, Tata McGraw Hill Publishing Company Ltd., New Delhi.

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- 1) Joanne M. Willey, Linda M. Sherwood and Christopher J. Woolverton. 2017. Prescott's Microbiology, 10th Edition, McGraw Hill Publication, United States.
- 2) Atlas, R.M and R. Bartha. 1998. Microbial Ecology. Fundamentals and Applications, 4th Edition, Red Wood City. C.A. Benjamin.
- 3) Bagyaraj, D. J and G. Rangasamy. 2002. Agricultural Microbiology, 2nd Edition, Prentice Hall, India.
- 4) Mahendra K. Rai. 2005. Hand book of Microbial Biofertilizers, The Haworth Press, Inc. New York.

P. Saranraj and M. Manigandan

Microscopy: An Overview



First Edition



JPS, Scientific Publications, India

Textbook

MICROSCOPY: AN OVERVIEW

Editor

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Dr. P. Saranraj is presently an Assistant Professor and Head at the Department of Microbiology, Sacred Heart College (Autonomous), Tirupattur, Tamil Nadu, India. Prior to this he has worked as a Senior Research Fellow in Department of Microbiology, Annamalai University for 3 years. He is having teaching experience of 9 years and he has guided 14 M.Sc students for their project. He has been involved with teaching and research in area of Microbiology. He received his Ph.D Microbiology degree from Annamalai University in 2013 and he was qualified in NET exam in 2017. He has published 185 papers (Citations - 4250, H - index: 38 and i10 index - 81) in peer reviewed International Journals, 60 Books and 30 Book chapters. He is an Editorial Board Member and Reviewer of 30 International Journals. And he has also involved himself in filing an International Innovation Patent granted by the Government of Australia (AusPat) for his research team's innovation on Silver Nanoparticles. He has deposited 6 Bacterial Sequence in NCBI and received the Accession Number. He was also conferred with awards like Best Review Paper Award (2011), Young Scientist Award (2013), Best Research Forum Coordinator Award (2017), Highest Book Publication Award (2017), Best Review Paper Award (2017), Highest Research Paper Publication Award (2018), Young Researcher Award (2018), Best Research Forum Coordinator Award (2019), Indian Microbiologists Society Young Scientist Award (2019), Highest Citations Award (2019), Best Research Forum Coordinator Award (2020), Research Excellence Award (2020), Young Academic Achiever Award (2020) and Microbiology Young Scientist Award (2021). According to AD Scientific Index World Scientist Ranking (Microbiology), his name was placed in 28th Rank in India Level, 111th Rank in Asia Level and 801th Rank in World. He is a life member in various organizations viz., Microbiologists Association, India and Asian PGPR Society.

ABOUT THE EDITOR - Dr. M. Manigandan



Dr. M. Manigandan is presently working as an Assistant professor in the Department of Microbiology, Sacred Heart College (Autonomous), Tirupattur, Tamilnadu, India. Before joining Sacred Heart College, he held the position of Senior Research Fellow in the UGC Major Research Project from 2013 to 2017 at the Department of Microbiology, Faculty of Science, Annamalai University, Annamalainagar, Chidambaram, Tamil Nadu, India. His research focus during this period was in the areas of Medical and Environmental Microbiology. Dr. Manigandan earned his Ph.D. in Microbiology from Annamalai University in 2018. Over the course of his career, he has contributed significantly to the scientific community with 23 research and review articles published in peer-reviewed international journals, as well as four books and two book chapters. Additionally, he has presented oral research papers at various international conferences. At present, Dr. Manigandan is engaged in research on the depolymerization of LDPE plastic wastes.

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4	Difference between Light Microscope and Electron Microscope	8
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6	Dark Field Microscope	12
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Semester – I
4 Hours
4 Credits

MB 103: FUNDAMENTALS OF MICROBIOLOGY

Objectives

- To make students to understand the Fundamentals in Microbiology.
- To know the basic principles and types of Light microscope and Electron microscope.
- To familiarize with detailed structure of Prokaryotes.
- To acquire knowledge on various Sterilization techniques.
- To learn the Microbial cultivation techniques and methods for isolation of microorganisms.

Course Outcomes

Microbiology has played a central role in all aspects of Biological sciences. An understanding of Microbiology is thus basics to Biological research. This course will familiarize the students with fundamental knowledge on Microbiology.

S.No.	Description	Cognitive Level (K-level)
CO-1	Develop an understanding of the Fundamentals of Microbiology.	K6, K2
CO-2	Define and understand the concept of Cell, Cell theory, Prokaryotes and Eukaryotes.	K1, K2
CO-3	Categorize the various types, principles and applications of Light microscope and Electron microscope.	K4
CO-4	Broad knowledge on the structure and functions of organelles of Bacteria.	K3, K6
CO-5	Demonstrate a clear understanding of microbial control mechanisms through Sterilization techniques and Antibiotics.	K2
CO-6	Evaluate the methods used for the cultivation and identification of bacteria.	K5

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)									Mean Scores of COs
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PS O1	PS O2	PS O3	PS O4	PS O5	PS O6	PS O7	PS O8	PS O9	
1	3	3	2	2	3	3	3	3	3	3	2	3	3	3	2	3	2.7
2	2	2	3	3	2	3	1	2	3	2	3	3	2	2	3	2	2.3
3	3	1	2	3	1	3	3	3	2	3	2	2	3	3	2	3	2.4
4	2	2	3	2	3	2	2	2	3	3	3	3	3	3	3	2	2.5
5	2	3	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2.1
6	3	2	2	3	3	2	3	3	2	3	3	3	3	3	2	3	2.6
Mean Overall Score																2.5	
Result																High	

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	10
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	20

Unit – I

Members of Microbial world; History and recent developments of Microbiology – Spontaneous generation and Biogenesis; Contributions of Anton van Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Ignaz Semmelweis, Dmitri Ivanoski, Martinus Beijerinck, Sergei Winogradsky, Alexander Fleming and Selman Waksman; Cell - Prokaryotes and Eukaryotes; Golden age of Microbiology; Branches and Scope of Microbiology.

Unit – II

History of Microscopy; Principles of Microscopy; Difference between Simple microscope and Compound microscope; Principle, Instrumentation and Applications - Bright field microscope, Dark field microscope, Phase contrast microscope, Fluorescence microscope and Electron Microscopy – SEM & TEM; Difference between SEM and TEM.

Unit – III

Bacteria – Ultrastructure; Morphological Classification (Gram positive and Gram negative), Shape and arrangement; Cell wall; Cell membrane; Cell inclusions; Ribosomes; Capsules and Slime layer; Gas vesicles; Endospore; Surface appendages – Flagella (Arrangement and Types of Motility), Fimbriae and Pili.

Unit – IV

Microbial control terminologies; Sterilization; Physical method – Drying, Dry heat, Moist heat, Filtration, Radiation; Quality control and sterility checking; Chemical method – Disinfection and Disinfectants; Chemotherapy terminologies; Antibiotics – Classification, Antimicrobial resistance and Antibiotic sensitivity test.

Unit – V

Stains and its types; Staining techniques – Simple staining, Differential staining (Gram staining & Acid fast staining), Special staining (Capsule staining, Metachromatic granule staining, Endospore staining & Flagella staining); Motility test; Culture techniques - Culture medium and its types; Biochemical Tests for bacterial identification.

Text Books

- 1) Gerard J. Tortora, Berdell R. Funke and Christine L. Case. 2015. Microbiology – An Introduction, 12th Edition, Peareson Publishers, San Francisco.
- 2) Joanne M. Willey, Linda M. Sherwood and Christopher J. Woolverton. 2017. Prescott's Microbiology, 10th Edition, McGraw Hill Publication, United States.
- 3) Reba Kanungo. 2017. Ananthanarayan and Paniker's Text book of Microbiology, 7th Edition, Orient Longman Limited, Chennai, India.
- 4) Saranraj, P. 2020. Basic Techniques in Microbiology. JPS Scientific Publications, India.

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- 1) Dubey, R.C. and D. K. Maheswari. 2010. A Text book of Microbiology. 3rd Edition, S. Chand and Company, New Delhi.
- 2) Chakraborty. 2003. A Text book of Microbiology. 2nd Edition, Published by New Central Book Agency (P) Ltd., Kolkata.
- 3) Pelczar Jr. M. J., Chan, E. C. S and Kreig, N. R. 2006. Microbiology. 5th Edition Mc Graw Hill Inc. New York.
- 4) Powar, C. B and H. F. Daginawala. 2008. General Microbiology. Volume – II, Himalaya Publishing House, Mumbai.

Semester – I
3 Hours
3 Credits

MICROBIAL DIVERSITY AND CLASSIFICATION**Objectives**

- To learn the Taxonomy of microorganisms.
- To analyze the Ultrastructure of Fungi, Algae and Protozoa.
- To understand the Classification of microorganisms.
- To recognize the fundamentals on Economic importance of microorganisms.
- To impart knowledge on Molecular identification of microorganisms.

Course Outcomes

The basic task of Microbial Diversity and Classification is to differentiate the various characteristics of microorganisms based on Ultrastructure and Classification. It enables the students to identify any microorganisms through Molecular identification. The students will be able to understand and predict the Economic importance of microorganisms.

S.No.	Description	Cognitive Level (K-level)
CO-1	Understand the knowledge of Classifications and Taxonomy of Microorganisms in detail	K2, K3
CO-2	Acquire the basic knowledge on the Ultrastructure, Classification, Mode of nutrition and Reproduction of Fungi, Algae and Protozoa.	K3
CO-3	Discuss the Economic importance of Fungi, Algae and Protozoa.	K2
CO-4	Examine and define the structure, properties and classification of Human, Plant and Animal viruses.	K1
CO-5	Explore and recommend the Molecular techniques applied in identification of microorganisms.	K4, K5
CO-6	Compile the basic information on the diversity and classification of Fungi, Algae, Protozoa and Algae.	K6

Generation; Metagenomics; CRISPR; Polymerase Chain Reaction (PCR), Types of PCR and Applications of PCR; Current Research Thoughts in Molecular Microbiology.

Text Books

- 1) Joanne M. Willey, Linda M. Sherwood and Christopher J. Woolverton. 2017. Prescott's Microbiology, 10th Edition, McGraw Hill Publication, United States.
- 2) Freifelder, D. 2008. Molecular Biology, 2nd Edition, Narose Book Distributors Pvt. Ltd., New Delhi, India.
- 3) Old, R. S and S. B. Primrose. 2006. Principles of Gene Manipulation, 7th Edition, Blackwell Scientific Publications, London.
- 4) Nelson, D. L and Cox, M. M. 2008. Leininger Principles of Biochemistry, 5th Edition, W.H. Freeman and Company.
- 5) Brown T. A. 1995. Gene Cloning. 4th Edition, Chapman and Hall.

References

- 1) Gardner, E. J., M. J. Simmons and D. P. Snustad. 2005. Principles of Genetics, 8th Edition, John Wiley and Sons, New York.
- 2) Klug, W. S and M. R. Cummings. 2001. Essentials of Genetics, 4th Edition, Prentice Hall, New Jersey.
- 3) Chatterjee, N and Rana Shinde. 2012. Textbook of Medical Biochemistry, 8th Edition, Jaypee publication, New Delhi, India.
- 4) Weaver, R. F. 2008. Molecular Biology, 5th Edition, McGraw Hill, New York.

Semester – I

4 Hours/3 Credits

ELECTIVE: MICROBIAL INSTRUMENTATION

Objectives

- To understand the principles and applications of various instruments used in Life science.
- To learn the techniques for operating the instruments.
- To study the concepts of Biological and Radiation hazard materials.
- To explain the principles and applications of types of centrifuge and chromatography techniques.
- To learn principles, types and applications of Spectroscopy.

Course Outcomes

Course Outcome (CO)	Description	Cognitive Level (K-Level)
CO-1	Determine the Safety measures in Microbiology laboratory.	K3
CO-2	Define and explain the principles and applications of various instruments used in Life science.	K1, K2
CO-3	Explain the Working principles and Applications of Various Microbiology laboratory instruments.	K4
CO-4	Analyzing the principles and applications of types of Chromatography techniques.	K4
CO-5	Evaluate the Working principle and Applications of Electrophoresis techniques.	K5

CO-6	Perform the detailed analysis on Calorimeter and Spectrophotometer.	K6
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Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)										Mean Scores of COs
	PO 1	PO 2	PO 3	PO 4	PO 5	PS O1	PS O2	PS O3	PS O4	PS O5	PS O6	PS O7	PS O8	PS O9	PSO 10	
1	3	3	3	3	3	2	2	3	3	3	3	3	3	2	3	2.8
2	2	2	3	3	3	3	3	3	3	3	2	3	2	2	2	2.6
3	2	3	2	3	2	3	2	3	2	3	3	2	3	3	3	2.6
4	3	3	3	2	3	2	3	2	3	3	3	3	3	2	3	2.7
5	3	2	3	2	3	3	2	3	3	3	3	1	2	2	3	2.8
6	3	3	1	3	3	3	3	2	3	3	3	3	3	3	3	2.5
Mean Overall Score															2.6	
Result															High	

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	10
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	20

Unit – I

History of Microscopy; Principles of Microscopy; Principle, Instrumentation and Applications - Bright Field Microscopy, Dark Field Microscopy, Phase Contrast Microscopy, Fluorescence Microscopy, Differential Interference Contrast (DIC) Microscopy, Confocal Scanning Laser Microscopy, Two – Photon Microscopy (TPM), Scanning Acoustic Microscopy (SAM), Electron Microscopy – Scanning Electron Microscopy (SEM) & Transmission Electron Microscopy (TEM), Scanned – Probe Microscopy – Scanning Tunneling Microscopy and Atomic Force Microscopy.

Unit – II

Bioinstruments - Principle, Instrumentation and Applications of pH Meter, Bacterial Incubator, Hot air oven, Autoclave, Colony counter, Lyophilizer and Laminar flow cabinet. Electrophoretic techniques - Principle, Instrumentation and Applications of Paper electrophoresis, Gel electrophoresis, Immunoelectrophoresis, Capillary electrophoresis and SDS-PAGE; Gel Documentation System.

Unit – III

Chromatographic techniques - Principle and Applications of Paper Chromatography (Ascending Paper Chromatography & Descending Paper Chromatography), Thin Layer Chromatography (TLC), Gel Filtration Chromatography, Adsorption Column Chromatography, Ion Exchange Chromatography, Affinity Chromatography, Countercurrent Chromatography (CCC), Gas Chromatography, High Performance Liquid Chromatography (HPLC) and HPTLC.

Unit – IV

Centrifugation techniques - Basic principles of Centrifuge; Types of Centrifuges – Small Bench Centrifuges, Large Capacity Refrigerated Centrifuges, High Speed Refrigerated Centrifuges and Ultracentrifuges; Different types of Rotors; Types of Centrifugation -

Differential centrifugation, Density gradient centrifugation and Centrifugal elutriation; Safety aspects of Centrifuges.

Unit – V

Spectroscopy - Principle, Instrumentation and Applications of Colorimeter, Spectrophotometer, UV-Vis Spectrophotometer, Flame Photometry, Atomic Absorption Spectroscopy, IR Spectrophotometry, Fourier Transform Infrared Spectroscopy (FT-IR), Nuclear Magnetic Resonance (NMR) and X – ray Crystallography; Biosensors – Basic characteristic, Components, Requirements, Types and Applications; Current Research Thoughts in Microbial Instrumentation.

Text Books

- 1) Arumugam, S. 2002. Biomedical Instrumentation, Anuratha Agencies Publishers, 2nd edition, India.
- 2) Asokan, P. 2001. Analytical Biochemistry, Chinnaa Publications, India.
- 3) Gurumani, N. 2014. Research Methodology for Biological Sciences, MJP Publisher, India.
- 4) Veerakumari, L. 2019. Bioinstrumentation, MJP Publisher, India.

References

- 1) Chatwal, G. R and S. K. Anand. 2003. Instrumental Methods of Chemical Analysis. 5th Edition, Himalaya Publishing House, Mumbai
- 2) Mandeep Singh. 2014. Introduction to Biomedical Instrumentation, Paperback publishers, India.
- 3) Sharma, B. K. 2007. Instrumental Methods of Chemical Analysis, Krishna Prakashan Media (P) Ltd, India.
- 4) Wilson, K., Walker, J., Clokie, S and Hofmann, A. 2018. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology 8th Edition, Cambridge University Press.

Semester – I

4 Hours/3 Credits

ELECTIVE: BIostatISTICS

Objectives

- To demonstrate the importance of data collection and presentation of data
- To perform methods used for measuring central tendency, deviation and error
- To discuss Probability theory and applications
- To explain Correlation, regression and hypothesis testing methods
- To identify appropriate method for analysis of variance and learn few statistical packages

Course Outcomes

Course Outcome (CO)	Description	Cognitive Level (K-Level)
CO-1	Classify the data and understanding the role of Biostatistics in research.	K2
CO-2	Provide basic knowledge of statistics and tools used for several quantitative analysis in Microbiology.	K1