

Savitribai Phule Pune University

(Formerly University of Pune)

Three Year B.Sc. Degree Program in Microbiology

(Faculty of Science & Technology)

S. Y. B. Sc. (Microbiology)

Choice Based Credit System Syllabus

2019 Pattern

Savitribai Phule Pune University, Pune-411007
Syllabus 2020-21
S. Y. B. Sc. Microbiology Semester III and Semester IV
Titles of the Papers

Semester	Paper Code	Paper	Paper title
III	MB 231	I	Medical Microbiology and Immunology
	MB 232	II	Bacterial Physiology and Fermentation Technology
	MB 233	III	Practical based on MB 231 and MB 232
IV	MB 241	I	Bacterial Genetics
	MB 242	II	Air, Water and Soil Microbiology
	MB 243	III	Practical based on MB 241 and MB 242

Equivalence of Previous Syllabus: S. Y. B. Sc. Microbiology

Semester	Old version (2019 Pattern)		Corrected version (2019 Pattern)	
	Course Number	Course title	Course Number	Course title
III	MB 211	Medical Microbiology and Immunology	MB 231	Medical Microbiology and Immunology
	MB 212	Bacterial Physiology and Fermentation Technology	MB 232	Bacterial Physiology and Fermentation Technology
	MB 213	Practical based on Theory papers MB 211 and MB 212	MB 233	Practical based on Theory papers MB 231 and MB 232
IV	MB 221	Bacterial Genetics	MB 241	Bacterial Genetics
	MB 222	Air, Water and Soil Microbiology	MB 242	Air, Water and Soil Microbiology
	MB 223	Practical based on Theory papers MB 221 and MB 222	MB 243	Practical based on Theory papers MB 241 and MB 242

S. Y. B. Sc. Microbiology Syllabus (Semester III)

MB-231: Medical Microbiology and Immunology

[2 Credits; 36 Lectures]

[1 credit=15 hrs x 60 mins = 900mins/50mins= 18 lectures]

MB-231	Medial Microbiology and Immunology	[36]
Credit I	Medical Microbiology	(18)
1	<p>Definitions:</p> <p>Incubation period, Viability, Susceptibility, Pathogenicity, Virulence, Pathogenesis, Lab diagnosis, Epidemic, Sporadic, Endemic, Pandemic</p>	2
2	<p>Study of following pathogens with respect to –</p> <p>Classification, Morphological, Cultural and Biochemical characters, Antigenic structure, Viability characteristics, Pathogenicity, Pathogenesis, Symptoms, Laboratory diagnosis, Epidemiology, Prophylaxis and Chemotherapy:</p> <p>Bacteria: a) <i>Escherichia coli</i> b) <i>Staphylococcus aureus</i></p> <p>Fungi: a) <i>Candida</i> b) <i>Dermatophytes</i></p>	10
3	<p>Introduction to Chemotherapy</p> <p>i. Selective toxicity, Bioavailability, MIC, MBC, LD50</p> <p>ii. Antagonism and synergism in drug administration</p> <p>iii. Antibiotic sensitivity</p> <p>iv. Antibiotic misuse/antibiotic overuse</p> <p>v. Concept of drug resistance (e.g. MRSA, ESBL)</p>	6
Credit II	Immunology	(18)
4	<p>Immunity:</p> <p>Definition, Types (Innate and acquired, active and passive, humoral and cell mediated)</p>	2
5	<p>Formation of blood cells (hematopoiesis):</p> <p>Myeloid and lymphoid lineages and differentiation process</p> <p>Lymphocyte types</p>	4

Credit II	Immunology	(18)
6	Antigens and antibodies: definition and concept	2
7	Immunoematology i. ABO and Rh blood group systems ii. Bombay blood group iii. Biochemistry of blood group substances iv. Inheritance of ABH antigens v. Medico legal applications of blood groups	7
8	Active and Passive Immunization i. Active Immunization -Whole organism vaccines a) Attenuated vaccines b) Inactivated Vaccines ii. Passive Immunization Transfer of preformed antibodies iii. Latest Immunization schedule in India	3

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1. Kanungo Reba. (2017). Ananthanarayan and Paniker's Textbook of Microbiology. Tenth edition. The Orient Blackswan Publisher. ISBN-13: 978-9386235251
2. Collins C. H., Lyne P. M., Grange J. M. and Falkinham J. O. III. (Editors). (2004). Collins and Lyne's Microbiological Methods. 8th edition. Arnold, London; Oxford
3. Finch R., Greenwood D., Whitley R. and Norrby S. R. (2010) Antibiotic and Chemotherapy. 9th Edition. Elsevier. ISBN: 9780702040641
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5. Dey N. C., Dey T. K. and Sinha D. (2013). Medical Bacteriology Including Medical

- Mycology and AIDS. 17th Edition. New Central Book Agency (P) Ltd (Publisher).
India
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 8. MacFaddin J. F. (2000). Oxidation- Fermentation Test. Biochemical Tests for Identification of Medical Bacteria. 3rd ed. Philadelphia: Lippincott Wilkins and Williams. 379-387. B, III
 9. Mukherjee K. L. and Ghosh S. (2010). Medical Laboratory Technology, Volume III: Procedure Manual for Routine Diagnostic Tests. 2nd edition. McGraw Hill Education(India) Private Limited. ISBN-13 : 978-1259061257
 10. Mukred A. M., Hamid A. A., Hamzah A. and Wan Mohtar Wan Yusoff W. M. W. (2008). Growth Enhancement of Effective Microorganisms for Bioremediation of Crude Oil Contaminated Waters. Pakistan Journal of Biological Sciences.11: 1708-1712.
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 12. Public Health England. (2019). Oxidation/fermentation of glucose test. UK Standards for Microbiology Investigations. TP 27 Issue 4. <https://www.gov.uk/uk-standards-formicrobiology-investigations-smi-quality-and-consistency-in-clinical-laboratories>
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 19. Shrivastava M., Navaid S., Peethambarakshan A., Agrawal K. and Khan A. (2015). Detection of rare blood group, Bombay (Oh) phenotype patients and management by

- acute normovolemic hemodilution. Asian journal of transfusion science. **9**(1):74–77
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23. Talwar G. P. (1983). Handbook of Immunology. Vikas Publishing Pvt. Ltd. NewDelhi.
24. Paul W. E. (2003): Fundamental Immunology. 5th edition. Lippincott Williams and Wilkins Publishers. ISBN: 9780781735148
25. Joklik W. K., Willett H. P., Amos D. B. and Wilfert C. M. 1995). Zinsser's Microbiology. 20th Edition. Appleton and Lange Publisher. ISBN-13: 978- 0838599839
26. Zajic J. E. and Supplisson B. (1972). Emulsification and degradation of “Bunker C” fuel oil by microorganisms. Biotechnol. Bioeng. 14: 331-343.

MB-232: Bacterial Physiology and Fermentation Technology**[2 Credits; 36 Lectures]****[1 credit=15 hrs x 60 mins = 900mins/50mins= 18 lectures]**

Credit I	Bacterial Physiology	(18)
1	Enzymes	
	i. Introduction to Enzymes: Properties of enzymes, Nature of active site, Structure of active site, commonly occurring amino acids at active site. Ribozymes, coenzymes, apoenzymes, prosthetic group and cofactors.	2
	ii. Nomenclature and classification as per IUB (upto class level).	2
	iii. Models for catalysis– a) Lock and key b) Induced fit c) Transition state.	1
	iv. Effect of pH and temperature, substrate concentration and enzyme concentration, activators and inhibitors of enzyme	3
2	Bacterial Physiology	
	i. Definitions of Metabolism, catabolism, anabolism, respiration and fermentation	1
	ii. Metabolic pathways (with structures)	
	a) Embden Meyerhof Parnas pathway (Glycolysis)	2
	b) Hexose monophosphate pathway	2
	c) Entner Doudoroff pathway	1
	d) Phosphoketolase pathway(Pentose and hexose)	1
e) TCA cycle (with emphasis on amphibolism) and Glyoxylate by pass	2	
f) Gluconeogenesis and its significance	1	

Credit II	Fermentation Technology	(18)
3	Concept of fermentation technology <ul style="list-style-type: none"> i. Microbial biomass- based fermentation (Biofertilizer, biopesticide and Probiotics) ii. Production of Primary metabolites (Organic acids, amino acids, vitamins and enzymes) iii. Production of Secondary metabolites (Antibiotics) iv. Production of recombinant products (insulin and growth hormones) v. Production of Fermented food products (Cheese, yoghurt) vi. Microbial biotransformation (Steroid transformation) 	4
4	Strains of industrially important microorganisms: <ul style="list-style-type: none"> i. Desirable characteristics of industrial strain ii. Principles and methods of primary and secondary screening iii. Master, working and seed culture; development of inoculum iv. Preservation and maintenance of industrial strains. 	5
5	Design of a Fermenter (typical CSTR Continuous stirred Tank Reactor): Different parts and their working	2
6	Monitoring of different fermentation parameters (Temperature, pH, aeration, agitation, foam)	2
7	Types of fermentations: Batch, continuous and dual	2
8	Media for industrial fermentations: Constituents of media (Carbon source, nitrogen source, amino acids, vitamins, minerals, water, buffers, antifoam agents, precursors, inhibitors and inducers)	2
9	Contamination: Sources, precautions and consequences	1

References:

1. BIOTOL Series. (1993). Biotechnology by open learning series. Defense Mechanisms. Butterworth and Heinemann Ltd., Oxford
2. Casida L. E. J. R. (2016). Industrial Microbiology. New Age International Private Limited. ISBN- 9788122438024

3. Conn E. E., Stumpf P. K., Bruening G., Doi R. Y. (1987). Outlines of Biochemistry. 5th Edition, John Wiley and Sons, New Delhi. (Unit I& II)
4. Madigan M. T., Martinko J. M. and Brock T. D. (2006). Brock's Biology of Microorganisms. Pearson Prentice Hall, Upper Saddle River.
5. Moat A. G. and Foster J. W. (1988). Microbial Physiology. 2nd Edition. John Wiley and Sons New York.
6. Nelson D. L. and Cox M. M. (2005). Lehninger's Principles of Biochemistry. 8th edition. Mac Millan Worth Pub. Co. New Delhi. ISBN:9781319228002
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9. Pepler H. L. and Perlman D. (1979). Microbial Technology. Volume II: Fermentation Technology (2nd Edition). Academic Press. ISBN: 9781483268279
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11. Reed G. (Editor). (1982). Prescott and Dunn's Industrial Microbiology. Westport, CT, AVI Publishing Co Inc.
12. Stanbury P. F., Whitaker A. and Hall S. J. (2016). Principles of Fermentation Technology. 3rd Edition. Butterworth-Heinemann. ISBN: 9780080999531
13. Voet D. and Voet J. G. (1995). Biochemistry. 2nd Edition. John Wiley & sons. New York. ISBN 0-471-58651-X

MB-233: Practical Course based on
MB-231: Diagnostic Microbiology and Immunology
and
MB-232: Bacterial Physiology and Fermentation Technology

[2 Credits: 78 Lectures]

[1 credit=15hrs x 130 mins = 1950 mins/50 mins=39 lectures]

78 L distributed as 60 L for performing practicals and 18 L for internal evaluation

12 Practical x 5 lectures = 60 Lectures

Semester III: Practical course based on MB 231 and MB 232		
Expt. No.	Topics	No. of Practical
1	Measurements of cell dimension by micrometry using 10x, 45x and 100x objectives	1
2	Blood grouping: ABO, Rh and Bombay blood group (anti H Lectin test)	1
3	<p>I. Biochemical characterization of bacteria:</p> <ul style="list-style-type: none"> a. Sugar utilization test b. Sugar fermentation test c. Triple Sugar iron agar d. IMViC e. Enzyme detection –Gelatinase, Catalase, Oxidase, Coagulase (free and bound) f. Oxidative-fermentative test [Baird Parker's modification of Hugh and Leifson's oxidative- fermentative (OF) basal medium for Gram Positive and Hugh and Leifson's oxidative- fermentative (OF) basal medium for Gram negative; Public Health England, 2019] <p>II. Isolation and identification of pathogens from clinical samples: <i>(Escherichia coli, Staphylococcus aureus and Candida)</i> by</p> <ul style="list-style-type: none"> a. Gram staining, motility (bacterial pathogens) and slide culture (<i>Candida</i> and dermatophytes) b. Cultural and Biochemical characteristics 	8

4	Primary screening of industrially important organisms: a. Organic acid/ Antibiotic producing microorganisms by crowded plate technique b. Microorganisms producing industrially important enzyme-amylase	2
	Total	12

References:**Experiment 1. Measurements of cell dimension by micrometry:-**

1. Dubey R. C. and Maheshwari D. K. (2002). Practical Microbiology. S. Chand and Company Limited, New Delhi, India
2. Gunasekaran P. (2007). Laboratory Manual In Microbiology. New Age International (P) Limited New Delhi, India
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Experiment 2. Blood grouping:-

1. Godkar D. P. (2003). Textbook of Medical Laboratory Technology. Bhalani Publishing House, New Delhi, India.
2. Mukherjee K. L. (2013). Medical Laboratory Technology. Second Edition. Volume III. McGraw-Hill Companies, India.

Experiment 3. I. a. Sugar utilization test:-

Minimal salt Medium (MSM with 1% sugar):

1. Mukred A. M., Hamid A. A., Hamzah A. and Wan Yusoff W. M. (2008). Enhancement of Biodegradation of Crude Petroleum-Oil in Contaminated Water by the Addition of Nitrogen Sources. Pakistan Journal of Biological Sciences, 11: 2122-2127.
2. Mahalingam B. L., Karuppan M. and Manickam V. (2013). Optimization of Minimal Salt Medium for Efficient Phenanthrene Biodegradation by Mycoplasma sp. MVMB2 Isolated from Petroleum Contaminated Soil Using Factorial Design Experiments. CLEAN - Soil, Air, Water. 41(1): 51–59. Wiley-VCH Verlag GmbH and Co. KGaA, Weinheim

Experiment 3. I. b. Sugar fermentation test:-**Phenol Red Broth Base:**

1. Aneja K. R. (2007). Experiments in Microbiology, Plant Pathology and Biotechnology. New

Age International, New Delhi, India

2. Dubey R. C. and Maheshwari D. K. (2002). Practical Microbiology. S. Chand and Company Limited, New Delhi, India
3. Mac Faddin J. F. (2000). Biochemical Tests for Identification of Medical Bacteria. United Kingdom: Lippincott Williams and Wilkins.

Experiment 3. I. c. Triple sugar Iron Agar:-

1. Jain A., Agarwal J. and Venkatesh V. (2018). Microbiology Practical Manual. 1st Edition. E-Book. Elsevier Health Sciences, India.
2. Mac Faddin J. F.(2000). Biochemical Tests for Identification of Medical Bacteria. United Kingdom:Lippincott Williams and Wilkins.
3. Randhawa V. S., Mehta G. and Sharma K. B. (2009). Practicals and Viva in Medical Microbiology. Second Edition. Elsevier (A Division of Reed Elsevier India Pvt. Limited).

Experiment 3. I. d. IMViC:-

1. Dubey R. C. and Maheshwari D. K. (2002). Practical Microbiology. S. Chand and Company Limited, New Delhi, India
2. Jain A., Agarwal J. and Venkatesh V. (2018). Microbiology Practical Manual. 1st Edition. E-Book. Elsevier Health Sciences, India.
3. Randhawa V. S., Mehta G. and Sharma K. B. (2009). Practicals and Viva in Medical Microbiology. Second Edition. Elsevier (A Division of Reed Elsevier India Pvt. Limited).
4. Verma A. S., Das S., and Singh A. (2014). Laboratory Manual for Biotechnology. S Chand and Company Limited, New Delhi, India

Experiment 3. I. e. Enzyme detection:-

1. Carroll K.C., Pfaller M. A., Landry M. L., McAdam A. J., Patel R., Richter S. S. and Warnock D. W. (Editors). (2019). Manual of Clinical Microbiology. 2 Volume Set. 12th Edition. John Wiley, USA
2. Dubey R. C. and Maheshwari D. K. (2002). Practical Microbiology. S. Chand and Company Limited, New Delhi, India
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4. Leber A. L. (2020). Clinical Microbiology Procedures Handbook. United States: Wiley.
5. Verhaegen J. and Heuck C. C . (Editors). (2003). Basic Laboratory Procedures in Clinical Bacteriology. Second Edition. Switzerland:World Health Organization.

Experiment 3. II. Isolation and identification of pathogens from clinical samples:-

1. Mac Faddin J. F. (2000). Biochemical Tests for Identification of Medical Bacteria. United

Kingdom:Lippincott Williams and Wilkins.

2. Randhawa V. S., Mehta G. and Sharma K. B. (2009). Practicals and Viva in Medical Microbiology. Second Edition. Elsevier (A Division of Reed Elsevier India Pvt. Limited).
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4. Verhaegen J. and Heuck C. C .(Editors). (2003). Basic Laboratory Procedures in Clinical Bacteriology. Second Edition. Switzerland:World Health Organization.

Experiment 4. Primary screening of industrially important organisms:-

1. Aneja K. R. (2007). Experiments in Microbiology, Plant Pathology and Biotechnology. New Age International, New Delhi, India
2. Dubey R. C. and Maheshwari D. K. (2002). Practical Microbiology. S. Chand and Company Limited, New Delhi, India
3. Gunasekaran P. (2007). Laboratory Manual in Microbiology. New Age International Private Limited, New Delhi, India.

S. Y. B. Sc. Microbiology Syllabus (Semester IV)

MB-241: Bacterial Genetics

[2 Credits; 36 Lectures]

[1 credit=15 hrs x 60 mins = 900mins/50mins= 18 lectures]

MB 241	Bacterial Genetics	[36]
Credit I	Topics	(18)
1	Understanding DNA: i. Experimental evidence for nucleic acid as genetic material. <ol style="list-style-type: none"> Discovery of transforming material (hereditary material): Griffith's experiment Avery and MacLeod experiment Gierer and Schramm Fraenkel-Conrat and Singer experiment (TMV virus) Hershey and Chase experiment 	7
	ii. Types of nucleic acids (DNA and RNAs)	1
	iii. Structure of DNA <ol style="list-style-type: none"> Structure of Nitrogen bases, Nucleoside, Nucleotide and polynucleotide chain Bonds involved in DNA structure Different forms of DNA 	2
2	iii. Prokaryotic DNA replication <ol style="list-style-type: none"> Models of DNA replication. (Conservative, semi-conservative and Dispersive) Meselson and Stahl's experiment (semi-conservative) Six basic rules of DNA replication Enzymes, proteins and other factors involved in DNA replication. Modes of DNA replication Rolling circle mechanism, theta and linear DNA replication 	8

Credit II	Title	(18)
3	i. Gene expression a. Concept of Genetic code and its properties b. Concept of transcription and translation	2
4	ii. Mutations and reversions Concept of Mutation and Types of mutations: Nonsense, Missense, Silent, Conditional lethal-temperature sensitive, Amber, Reverse, suppressor a. Spontaneous Mutation <ul style="list-style-type: none"> • Discovery of spontaneous mutation (Fluctuation test) • Mechanism of spontaneous mutation • Isolation of Mutants: Replica plate technique b. Concept of Induced Mutations <ul style="list-style-type: none"> • Base pair substitution (Transitions, Transversions), Insertions and deletions-Frame / Phase shift mutations • Physical Mutagenic agent: UV and Xray • Chemical mutagenic agents • Base analogues (2amino purine, 5bromouracil), • HNO₂, Alkylating agents • Intercalating agents (EtBr, acridine orange) 	10
5	iii. Plasmid genetics a. Types of plasmids b. Properties of Plasmid c. Plasmid replication d. Plasmid incompatibility e. Plasmid curing f. Plasmid amplification Concept	6

References:

1. Brooker R. J. (2012). Genetics: Analysis and Principles. 4th edition. McGraw-HillPublication
2. Alberts B., Johnson A., Lewis J., Raff M., Roberts K. and Walter P. (2008). Molecular Biology of the Cell. 5th Edition. Garland Science. Taylor and Francis. ISBN: 978-0-8153-4105-5. .
3. Malacinski G. M. (2005). Freidfelder's Essentials of Molecular Biology. 4th Edition. Jones and Bartlett Publishers, Inc
4. Gardner E. J., Simmons M. J. and Snustad D. P. (2006). Principles of Genetics. 8th edition. John Wiley and Sons Publication. ISBN-13: 9788126510436
5. Hayes W. (2nd Edition). (1968). Genetics of Bacteria and their Viruses. Oxford-Edinburgh: Blackwell Scientific Publications.
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8. Lodish H., Berk A., Kaiser C. A., Krieger M., Bretscher A., Ploegh H., Martin K. C., Yaffe M. and Amon A. (2021). Molecular Cell Biology, 9th Edn. Macmillan Learning. ISBN: 9781319208523
9. Pawar and Daginawala. General Microbiology. Vol. I and vol II. 1st Edition. Himalaya Publishing House, Mumbai
10. Primrose S. B. (2002) .Principles of Gene Manipulation. 6th Edition. Oxford: Blackwell Scientific Publications
11. Russel P. J. (2000). Fundamentals of Genetics. Publisher: Benjamin/Cummings. ISBN:9780321036261
12. Russel P. J. (2010). iGenetics: A Molecular Approach. 3rd Edition. Benjamin Cummings. ISBN: 9780321569769
13. Stanier R. Y. (2003). General Microbiology. United Kingdom: Palgrave Macmillan Limited.
14. Strickberger M. W. (2012). Genetics. 3rd Edition. New Delhi: PHI Learning Gardner

S. Y. B. Sc. Microbiology Syllabus (Semester IV)

MB-242: Air, Water and Soil Microbiology

[2 Credits; 36 Lectures]

[1 credit=15 hrs x 60 mins = 900mins/50mins= 18 lectures]

MB-242	Air, Water and Soil Microbiology	[36]
Credit I	Air Microbiology and Water Microbiology	18
1	i. Air Microbiology	
	a. Air flora <ul style="list-style-type: none"> • Transient nature of air flora • Droplet, droplet nuclei and aerosols 	1
	b. Methods of Air sampling and types of air samplers <ul style="list-style-type: none"> • Impaction on solids • Impingement in liquid • Sedimentation • Centrifugation 	3
	c. Air sanitation: Physical and chemical methods	2
	d. Airborne infections	1
2	ii. Water Microbiology	
	a. Types of water: surface, ground, stored, distilled, mineral and de-mineralized water	1
	b. Recommended Bacteriological standards of Water Quality <ul style="list-style-type: none"> • Maharashtra Pollution Control Board (MPCB) Main Functions of MPCB Water quality standards for best designated usages • Central Pollution Control Board(CPCB) Main Functions of CPCB Designated Best Use Water Quality Criteria 	1
	c. Water purification methods	2
	d. Water borne Infections	1

	e. Indicators of faecal pollution: <i>Escherichia coli</i> , <i>Bifidobacterium</i> , <i>Streptococcus faecalis</i> , <i>Clostridium perfringens</i> , New indicators: <i>Campylobacter</i> and <i>Pseudomonas</i>	2
	f. Bacteriological analysis of water for potability i. Bacteriological standards of potable water: Bureau of Indian standards (BIS) ii. World Health Organization(WHO) iii. Presumptive coliform count iv. Confirmed test v. Completed test vi. Eijkman test vii. Membrane filter technique	4
Credit II	Soil Microbiology	18
	a. Rhizosphere microflora and its role in the rhizosphere	1
	b. Role of microorganisms in composting and humus formation	2
	c. Biofertilizers: Bacterial, Cyanobacterial, fungal and their large-scale production	3
	d. Biocontrol agents: Bacterial, Viral, Fungal and their large-scale production	3
	e. Brief account of microbial interactions: Symbiosis, Neutralism, Commensalism, Competition, Ammensalism, Synergism, Parasitism and Predation	5
	f. Role of microorganisms in elemental cycles in nature: Carbon, Nitrogen	4

References:

1. Aithal S. C. and Kulkarni N. S. (2015). Water microbiology ~ an Indian perspective. Published by Himalaya Publishing House, IstEdition. ISBN: No.: 978-93-5202-129-1.
2. Dube H. C. and Bilgrami K. S. (1976). Textbook of modern pathology. Vikas publishing house. New Delhi.
3. Dubey R. C. and Maheswari D.K. Textbook of Microbiology. S. Chand Publishing. ISBN: 9788121926201

4. Frobisher M. (1974). Fundamentals of Microbiology. 9th Edition. Saunders, Michigan University Press. ISBN: 9780721639222
5. Ingraham C. A. and Ingraham J. L. (2000). Introduction to Microbiology. United Kingdom: Brooks/Cole.
6. Lim D. V. (1989). Microbiology. 2nd Edition. West Publishing Company. ISBN: 9780314262066
7. Madigan M. T., Thomas Brock T., Martinko J., Clark D. P. and Paul D. P. (2009). Brock's Biology of Microorganisms. Pearson/Benjamin Cummings. ISBN: 9780132324601
8. Martin A. (1977). An Introduction to Soil Microbiology. 2nd edition. John Wiley & Sons Inc. New York & London.
9. Martin A. Introduction to Soil Microbiology. (1961). John Wiley & Sons, New York and London publication
10. MPCB, CPCB, BIS and WHO websites guidelines for drinking water quality
11. Pawar C. B. and Daginawala H.F. (1982). General Microbiology. Vol. I and II. 1st Edition. Himalaya Publishing House, Mumbai. ISBN: 9789350240892 and ISBN 9789350240908
12. Pelzar M. J., Chan E. C. S. and Krieg N. R. (1986). Microbiology. 5th Edition. McGraw-Hill Publication
13. Prescott L. M., Harley J. P. and Klein D. A. (2006). Microbiology. 6th Edition. McGraw Hill Higher Education. ISBN-13: 978-0-07-295175-2
14. Rangaswami G. (1979) Recent advances in biological nitrogen fixation. Oxford and IBH. New Delhi.
15. Salle A. J. (1971). Fundamental Principles of Bacteriology. 7th Edition. Tata MacGraw Publishing Co.
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17. Stanier R. Y. (2003). General Microbiology. United Kingdom: Palgrave Macmillan Limited.
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19. Tortora G. J., Funke B. R. and Case C. L. (2016). Microbiology: An introduction 12th Edition, Pearson. ISBN-13: 9780321929150

S.Y. B. Sc. Microbiology Syllabus (Semester IV)

MB-243: Practical Course based on

MB-241: Bacterial Genetics and MB-242: Air, Water and Soil Microbiology

[2 Credits: 78 Lectures]

[1 credit=15hrs x 130 mins = 1950 mins/50 mins=39 lectures]

78 L distributed as 60 L for performing practicals and 18 L for internal evaluation

12 Practical x 5 lectures = 60 Lectures

Semester IV: MB-243: Practical course based on MB 241and MB 242		
Expt. No.	Topics	No. of Practicals
1	Air sampling using an air sampler , calculation of air flora from different locations with the knowledge of respective standards of bacterial and fungal counts.	1
2	Air Flora: a. Diversity determination. b. Simpson index and settling velocity determination	1
3	Bacteriological tests for potability of water a. MPN, Confirmed and Completed test. b. Membrane filter technique (Demonstration)	4
4	Enrichment, Isolation, Preparation and Application of Bioinoculant i. a) <i>Azotobacter</i> species and b) <i>Rhizobium</i> species or ii. Blue Green Algae (cyanobacteria)	2
5	a. Induction of mutations by using physical mutagen (e.g. U V rays) and chemical mutagen (e.g. HNO ₂) b. Isolation of mutants by any suitable method c. Demonstration of UV survival curve	3
6	Visit to Industry/ Drinking Water treatment plant	1
	Total	12

References:**Experiment no.1. Air sampling using an air sampler:**

1. Chosewood L. C. and Wilson D. E. (2007). Biosafety in Microbiological and Biomedical Laboratories. DIANE Publishing Company. USA
2. Crawford R. L. and Garland J. L. (2007). Manual of Environmental Microbiology. United States: ASM Press.
3. Geis A. P. (2020). Cosmetic Microbiology: A Practical Approach. United States: CRC Press.
4. Nakatsu C. H., Yates M. V., Miller R. V. and Pillai S. D. (2020). Manual of Environmental Microbiology. United States: Wiley.
5. Pepper I. L., Brendecke J. W. and Gerba C. P. (2011). Environmental Microbiology: A Laboratory Manual. Netherlands: Elsevier Science.
6. WHO Guidelines for Indoor Air Quality: Dampness and Mould. (2009). Philippines: WHO.

Experiment no.2. Air Flora:

1. Aneja K. R. (2007). Experiments in Microbiology, Plant Pathology and Biotechnology. New Age International, New Delhi, India
2. Cox C. C. and Wathes C. M. (2020). Bioaerosols Handbook. United States: CRC Press.
3. Saxena J., Baunthiyal M. and Ravi I. (2015). Laboratory Manual of Microbiology, Biochemistry and Molecular Biology. Scientific Publishers, Jodhpur, Rajasthan, India.
4. Verma A. S., Das S., and Singh A. (2014). Laboratory Manual for Biotechnology. S Chand and Company Limited, New Delhi, India

Experiment no.3. Bacteriological tests for potability of water

1. Aneja K. R. (2007). Experiments in Microbiology, Plant Pathology and Biotechnology. New Age International, New Delhi, India
2. Atlas R. M. (1986; Digitized 2007). Basic and Practical Microbiology. United Kingdom: Macmillan.
3. Dubey R. C. and Maheshwari D. K. (2002). Practical Microbiology. S. Chand and Company Limited, New Delhi, India
4. Nollert L. M. L. and De Gelder L. S. P. (2013). Handbook of Water Analysis, Third Edition. United States: Taylor and Francis.

Experiment no. 4.**4.i. a) Azotobacter species:**

1. Aneja K. R. (2007). Experiments in Microbiology, Plant Pathology and Biotechnology. New Age International, New Delhi, India

2. Dubey R. C. and Maheshwari D. K. (2002). Practical Microbiology. S. Chand and Company Limited, New Delhi, India
3. Gunasekaran P. (2007). Laboratory Manual In Microbiology. New Age International (P) Limited New Delhi, India

4.i. b) *Rhizobium* species:

1. Aneja K. R. (2007). Experiments in Microbiology, Plant Pathology and Biotechnology. New Age International, New Delhi, India
2. Dubey R. C. and Maheshwari D. K. (2002). Practical Microbiology. S. Chand and Company Limited, New Delhi, India
3. Gunasekaran P. (2007). Laboratory Manual In Microbiology. New Age International (P) Limited New Delhi, India

4.ii. Blue Green Algae (cyanobacteria):

1. Aneja K. R. (2007). Experiments in Microbiology, Plant Pathology and Biotechnology. New Age International, New Delhi, India
2. Bisen P. S. (2014). Laboratory Protocols in Applied Life Sciences. United Kingdom: CRC Press.
3. Dubey R. C. and Maheshwari D. K. (2002). Practical Microbiology. S. Chand and Company Limited, New Delhi, India
4. Kumar V. (2012). Laboratory Manual of Microbiology. Scientific Publishers, Jodhpur, Rajasthan, India

Experiment no. 5. Induction of mutations:

1. Bisen P. S. (2014). Laboratory Protocols in Applied Life Sciences. United Kingdom: CRC Press.
2. Gunasekaran P. (2007). Laboratory Manual In Microbiology. New Age International (P) Limited New Delhi, India