

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's
New Arts, Commerce and Science College, Ahmednagar
(Autonomous)

(Affiliated to Savitribai Phule Pune University, Pune)



Choice Based Credit System (CBCS)
Bachelor of Science (B.Sc.)

Syllabus of
S. Y. B. Sc. Microbiology

Implemented from
Academic Year 2022 - 23

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's
New Arts, Commerce and Science College, Ahmednagar
(Autonomous)

Board of Studies in Microbiology

| Sr. No. | Name | Designation |
|---------|-------------------------|--------------------------|
| 1. | Mr. Kukreja Girish P. | Chairman |
| 2. | Ms. Giramkar Dipali D. | Member |
| 3. | Dr. Dixit Prashant P. | Academic Council Nominee |
| 4. | Dr. Naphade Bhushan S. | Academic Council Nominee |
| 5. | Mr.Choure Rajendra G. | Vice Chancellor Nominee |
| 6. | Mr. Yewatkar Saikiran | Alumni |
| 7. | Mr. Dube Chandrakant G. | Industry Expert |
| 8. | Dr. Patil Ulhas K. | Member (co-opt) |
| 9. | Mr.Shaikh Sajid H. | Member (co-opt) |
| 10. | Dr. Gahile Yogesh R. | Member (co-opt) |
| 11. | Mr.Wani Ashish S. | Member (co-opt) |

3. Programme Structure and Course Titles: (All academic years)

| Sr. No. | Class | Semester | Course Code | Course Title | Credits |
|---------|------------|----------|--------------|--|---------|
| 1. | F.Y. B.Sc. | I | BSC-MR 101 T | Introduction to Microbiology | 02 |
| 2. | F.Y. B.Sc. | I | BSC-MR 102 T | Basic Techniques in Microbiology | 02 |
| 3. | F.Y. B.Sc. | I | BSC-MR 103 P | Practical Course based on Theory Paper I and II | 1.5 |
| 4. | F.Y. B.Sc. | II | BSC-MR 201 T | Cell Biology of Microorganisms | 02 |
| 5. | F.Y. B.Sc. | II | BSC-MR 202 T | Microbial Cultivation and Growth | 02 |
| 6. | F.Y. B.Sc. | II | BSC-MR 203 P | Practical Course based on Theory Paper I and II | 1.5 |
| 7. | S.Y. B.Sc. | III | BSC-MR 301 T | Medical Microbiology and Immunology | 02 |
| 8. | S.Y. B.Sc. | III | BSC-MR 302 T | Bacterial Physiology and Fermentation Technology | 02 |
| 9. | S.Y. B.Sc. | III | BSC-MR 303 P | Practical Course based on Theory Paper I and II | 02 |
| 10. | S.Y. B.Sc. | IV | BSC-MR 401 T | Bacterial Genetics | 02 |
| 11. | S.Y. B.Sc. | IV | BSC-MR 402 T | Air ,Water & Soil Microbiology | 02 |
| 12. | S.Y. B.Sc. | IV | BSC-MR 403 P | Practical Course based on Theory Paper I and II | 02 |
| 13. | T.Y. B.Sc. | V | BSC-MR 501 T | Medical Microbiology I | 02 |

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| 14. | T.Y. B.Sc. | V | BSC-MR 502 T | Immunology I | 02 |
| 15. | T.Y. B.Sc. | V | BSC-MR 503 T | Enzymology | 02 |
| 16. | T.Y. B.Sc. | V | BSC-MR 504 T | Genetics and Molecular Biology I | 02 |
| 17. | T.Y. B.Sc. | V | BSC-MR 505 T | Fermentation Technology I | 02 |
| 18. | T.Y. B.Sc. | V | BSC-MR 506 T | Applied Microbiology I | 02 |
| 19. | T.Y. B.Sc. | V | BSC-MR 507 T | Nanotechnology | 02 |
| 20. | T.Y. B.Sc. | V | BSC-MR 508 P | Practical Course I- Diagnostic Microbiology and Immunology | 02 |
| 21. | T.Y. B.Sc. | V | BSC-MR 509 P | Practical Course II- Biochemistry and Molecular Biology | 02 |
| 22. | T.Y. B.Sc. | V | BSC-MR 510 P | Practical Course III- Fermentation Technology and Applied Microbiology | 02 |
| 23. | T.Y. B.Sc. | V | BSC-MR 511 P | Practical Course based on Nanotechnology | 02 |
| 24. | T.Y. B.Sc. | VI | BSC-MR 601 T | Medical Microbiology II | 02 |
| 25. | T.Y. B.Sc. | VI | BSC-MR 602 T | Immunology II | 02 |
| 26. | T.Y. B.Sc. | VI | BSC-MR 603 T | Metabolism | 02 |
| 27. | T.Y. B.Sc. | VI | BSC-MR 604 T | Genetics and Molecular Biology II | 02 |
| 28. | T.Y. B.Sc. | VI | BSC-MR 605 T | Fermentation Technology II | 02 |
| 29. | T.Y. B.Sc. | VI | BSC-MR 606 T | Applied Microbiology II | 02 |
| 30. | T.Y. B.Sc. | VI | BSC-MR 607 T | Molecular and Biochemical Techniques | 02 |

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| 31. | T.Y. B.Sc. | VI | BSC-MR 608 P | Practical Course I- Diagnostic Microbiology and Immunology | 02 |
| 32. | T.Y. B.Sc. | VI | BSC-MR 609 P | Practical Course II- Biochemistry and Molecular Biology | 02 |
| 33. | T.Y. B.Sc. | VI | BSC-MR 610 P | Practical Course III- Fermentation Technology and Applied Microbiology | 02 |
| 34. | T.Y. B.Sc. | VI | BSC-MR 611 P | Project /Practical course based on Molecular and Biochemical Techniques | 02 |

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's
New Arts, Commerce and Science College, Ahmednagar (Autonomous)
Syllabus of S. Y. B. Sc. Microbiology

Under
Faculty of Science and Technology

| Semester – III | Paper – I |
|----------------------------------|---|
| Course Code: BSC-MR 301 T | Title of the Course: Medical Microbiology and Immunology |
| Credits: 02 | Total Lectures: 30 Hrs. |

Course Outcomes (COs):

- a. Students will understand the definitions of terms in Medical Microbiology and will study different bacterial and fungal pathogens
- b. Students will understand the desirable parameters of Chemotherapeutic agent, Antibiotic sensitivity and misuse as well as concept of drug resistance
- c. Students will understand classification of immunity
- d. Students will understand ABO and Rh blood groups system and different types of immunization.

Detailed Syllabus:

| Unit No. | Topic | No. of Hours |
|-----------------|---|---------------------|
| Unit 1 | Medical Microbiology 1. Definitions: <ul style="list-style-type: none">• Incubation period, Susceptibility, Pathogenicity, Virulence, Pathogenesis, Lab diagnosis, Epidemic, Sporadic, Endemic, Pandemic 2. Study of following pathogens with respect to – Classification, Morphological, Cultural and Biochemical characters, Antigenic structure, Viability characteristics, Pathogenicity, Pathogenesis, Symptoms, Laboratory | 10 |

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| | <p>diagnosis, Epidemiology, Prophylaxis and Chemotherapy:</p> <ul style="list-style-type: none"> • Bacteria: a) <i>Escherichia coli</i> b) <i>Staphylococcus aureus</i> • Fungi: a) <i>Candida</i> b) <i>Dermatophytes</i> | |
| Unit 2 | <p>Introduction to Chemotherapy</p> <ol style="list-style-type: none"> 1. Desirable parameters of chemotherapeutic agent (Selective toxicity, Bioavailability of Drug, MIC, MBC, LD-50 value, routes of drug administration) 2. Antibiotic sensitivity, 3. Antibiotic misuse/antibiotic overuse 4. Concept of drug resistance (e.g. MRSA, ESBL) | 05 |
| Unit 3 | <p>Immunology</p> <ol style="list-style-type: none"> 1. Three lines of defenses, Innate vs acquired Immunity, Humoral Immunity and cell mediated Immunity 2. Primary and secondary immune response (Humoral) 3. Formation of blood cells (hematopoiesis) 4. Basic structure of antibody and concept of antigen. | 07 |
| Unit 4 | <p>1. Immuno-hematology</p> <ol style="list-style-type: none"> a. ABO and Rh blood group systems b. Bombay blood group c. Biochemistry of blood group substances d. Inheritance of ABH antigens e. Medico legal applications of blood groups <p>2. Active and Passive Immunization</p> <ol style="list-style-type: none"> a. Active Immunization Whole organism vaccines <ol style="list-style-type: none"> i. Attenuated vaccines ii. Inactivated Vaccines b. Passive Immunization <p>Transfer of preformed antibodies</p> | 08 |

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| | c. Latest Immunization schedule in India | |
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Suggested Readings:

1. Davis B. D., Delbacco, 1990 Microbiology 4th edition, J.B. Lippincott Co. NY
2. Wolfgang K. Joklik, 1992, Zinsser Microbiology 20th Edition, McGraw-Hill Professional Publishing.
3. Dey, N.C and Dey, T. K. 1988, Medical Bacteriology, Allied Agency, Calcutta, 17th Edition
4. Ananthnarayan, R. and C. K, Jayaram Panikar, 1996 Textbook of Microbiology, 5th edition, Orient Longman.
5. David Greenwood, 1995, Antimicrobial Chemotherapy, 3rd Edition, Oxford University Press.
6. Mukherjee, K. L 1988, Medical Laboratory Technology, Vol III, 10th Edition, Tata McGraw Hill Education
7. Medical Microbiology edited by Samuel Baron. 4th edition. (University of Texas Medical Branch of Galveston)
8. Kubly J. Graw-Hill Pub Co(1996) Immunology 3rd Ed. W. H. Freeman & Co.
9. Sudha Gangal, Shubhangi Sontakke. (2012) Textbook of Basic and Clinical Immunology. Universities Press Private limited.
10. Pathak S. S. and Palan V. (1997) Immunology - Essential and Fundamental, Preen Publications Bombay.
11. Roitt Evan, Brostoff J. Male D. (1993) Immunology 6th Ed., Mosby & Co. London.
12. Roitt I. M. (1988) Essentials of Immunology, ELBS, London.
13. Roitt M. (1984) Essentials of Immunology, P. G. Publishers Pvt. Ltd., New Delhi.
14. Talwar G. P. (1983) Handbook of Immunology, Vikas Publishing Pvt. Ltd. New Delhi.
15. Stites D. P., Stobo J. D., Fudenberg H. H. and Wells J. V., (1982), Basic and Clinical Immunology, 4th Ed., Lange Medical Publications, Maruzen Asia Pvt. Ltd., Singapore.

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| Semester – III | Paper – II |
| Course Code: BSC-MR 302 T | Title of the Course: Bacterial Physiology and Fermentation Technology |
| Credits: 02 | Total Lectures: 30 Hrs. |

Course Outcomes (COs):

- Students will understand working, structure and function of enzyme.
- Students will learn various metabolic pathways and their importance.
- Students will learn important upstream components of fermentation process including screening and maintenance of industrial strains, inoculum development, fermentation media design, monitoring of fermentation parameters etc.
- Students will learn about types of fermentation products, fermenter design, different types of fermentations and contamination of fermentation process

Detailed Syllabus:

| Unit No. | Topic | No. of Hours |
|-----------------|--|---------------------|
| Unit 1 | Enzymes <ol style="list-style-type: none"> Introduction to Enzymes: Basic structure and function of enzyme <ol style="list-style-type: none"> Holoenzyme, Coenzymes, Cofactors, Prosthetic groups, Active Site Working of enzyme-Activation energy, transition state. Ribozymes and Abzymes Nomenclature & classification as per IUB (up to class level), EC number (with the explanation of tripeptide aminopeptidase) Models for catalysis – <ol style="list-style-type: none"> Lock and key Induced fit Transition state. Effect of pH & temperature, substrate concentration & | 07 |

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| | <p>enzyme concentration.</p> <p>5. Enzyme Inhibitors and their types.</p> <p>6. Applications of enzymes</p> | |
| Unit 2 | <p>Bacterial Physiology</p> <ol style="list-style-type: none"> 1. Definitions of Metabolism, catabolism, anabolism, respiration and fermentation 2. Metabolic pathways (with structures) <ol style="list-style-type: none"> a. Embden Meyerhof Parnas pathway (Glycolysis) b. Hexose monophosphate pathway c. Entner Doudoroff pathway d. TCA cycle (with emphasis on amphibolism) 3. Electron Transport Chain- components, mechanism of ATP synthesis | 08 |
| Unit 3 | <p>Introduction to Fermentation Technology</p> <p>1.Type of Fermentation Products:</p> <ol style="list-style-type: none"> a. Microbial biomass- based fermentation products (Bio fertilizer, bio pesticide, Probiotics) b. Primary metabolites (Organic acids, amino acids, vitamins, enzymes) c. Secondary metabolites (Antibiotics) d. Recombinant products (insulin and growth hormones) e. Fermented food products (Cheese, yoghurt) f. Microbial bio transformation (Steroid transformation) <p>2. Strains of industrially important microorganisms:</p> <ol style="list-style-type: none"> a. Desirable characteristics of industrial strain b. Principles and methods of primary and secondary screening c. Master, working and seed culture; development of inoculum d. Preservation and maintenance of industrial strains. | 07 |
| Unit 4 | Fermentation process | |

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| | <ol style="list-style-type: none"> 1. Design of a Fermenter (typical CSTR Continuous stirred Tank Reactor): Different parts and their working 2. Monitoring of different fermentation parameters (Temperature, pH, aeration, agitation, foam) 3. Types of fermentations: Batch, continuous, fed batch , dual 4. Media for industrial fermentations: Constituents of media (Carbon source, nitrogen source, amino acids vitamins, minerals, water, buffers, antifoam agents, precursors, inhibitors, and inducers) 5. Contamination: Sources, precautions, and consequences | 08 |
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Suggested Readings:

1. Conn E.E., Stumpf P.K., Bruening G., Doi R.Y. (1987) Outlines of Biochemistry 5th Ed , John Wiley and Sons, New Delhi. (Unit I & II)
2. Moat A.G. & Foster J.W. (1988) Microbial Physiology 2nd Ed. John Wiley and Sons New York. (Unit II & III)
3. Nelson D. L. & Cox M. M. (2005) Lehninger's Principles of Biochemistry, 4th edition. H. Freeman & Co. NY (Unit II & III)
4. Voet D. & Voet J. G. (1995) Biochemistry, 2nd Ed.. John Wiley & sons New York. (Unit II & III)
5. Madigan M. T., Martinko J. M. (2006) Brock's Biology of Microorganisms. 11th Edition, Pearson Education Inc. (Unit I, II& III)
6. Prescott L. M., Harley J. P. and Klein D. A. (2005) Microbiology, 6th Edition. MacGraw Hill Companies Inc.(Unit II)
7. A. H. Patel. (1985), Industrial Microbiology, Macmillan India Ltd.
8. Bioreactor Design and Product Yield (1992),BIOTOL series, Butterworths Heinemann.
9. Casida, L. E., (1984), Industrial Microbiology, Wiley Easterbs, New Delhi

10. Peppler, H. L (1979), Microbial Technology, Vol I and II, Academic Press, New York.
11. Peter F. Stanbury. Principles of Fermentation Technology, 2E, Elsevier (A Division of Reed Elsevier India Pvt. Limited), 2009
12. Prescott, S.C. and Dunn, C. G., (1983) Industrial Microbiology, Reed G. AVI tech books.
13. Reed G. Ed. Prescott and Dunn's Industrial Microbiology. 4th Ed., CBS Pub. New Delhi.
14. Stanbury, P. F. and Whittaker, A. (1984) Principles of Fermentation technology, 1st edition, Pergamon press.

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| Semester – III | Paper – III |
| Course Code: BSC-MR 303 P | Title of the Course: Practical Course based on Theory Paper I and II |
| Credits: 02 | Total Lectures: 60 Hrs. |

Course Outcomes (COs):

- Students will be able to determine cell dimensions using micrometry and perform blood grouping
- Students will be able to perform biochemical characterization of bacteria
- Students will be able to isolate and identify bacteria from clinical sample and know how to use Bergey's Manual of Determinative Bacteriology.
- Students will be able to carry out primary screening of antibiotic and enzyme producing microorganisms from soil sample.

Detailed Syllabus:

| Sr.No. | Title of the Experiment | No. of Practical |
|---------------|--|-------------------------|
| 1. | Determination of calibration factor of an ocular micrometer. Measurements of cell dimension by micrometry using 10x,45x,100x objectives | 1 |
| 2. | Blood grouping | 1 |
| 3. | Biochemical characterization of bacteria: a. Sugar utilization test (minimal medium + sugar) b. Sugar fermentation test c. IMViC test d. Enzyme detection – Gelatinase, Catalase, Oxidase e. Oxidative-fermentative test | 6 |

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| 4. | Isolation and identification of <i>E. coli</i> / <i>Staphylococcus aureus</i> and <i>Candida</i> from clinical samples using- a. Gram staining, motility/ slide culture b. Cultural and biochemical characterization | 4 |
| 5. | 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 | 14 |

Suggested Readings:

1. Harley, J.P. and Prescott, L.M., (2002). Laboratory Exercises in Microbiology, 5th Edition, The McGraw-Hill Companies.
2. Saravanan R., Dhachinamoorthi D., CH. M.M., Prasada Rao (2013). 1st Edition, A Handbook of Practical Microbiology, LAP LAMBERT Academic Publishing.
3. Goldman and E., Green H.L. (2015) Practical Handbook of Microbiology 3rd Edition, CRC Press.
4. Subhash Chandra Parija, Practical Microbiology For Under Graduate Medical Students (2018), Ahuja Publishing House.
5. Dubey R.C. and Maheshwari D.K., Practical Microbiology (2002), 1st Edition, S.Chand Publication

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| Semester – IV | Paper – I |
| Course Code: BSC-MR 401 T | Title of the Course: Bacterial Genetics |
| Credits: 02 | Total Lectures: 30 Hrs. |

Course Outcomes (COs):

- Students will understand the different experiments proving nucleic acid as genetic material and learn the basic structure, properties and types of nucleic acid and Mechanism and modes of prokaryotic DNA replication
- Students will understand concept of gene and gene expression like transcription and translation
- Students will learn spontaneous mutation and induced mutations due to different mutagenic agents
- Student will be able to understand plasmid genetics

Detailed Syllabus:

| Unit No. | Topic | No. of Hours |
|-----------------|--|---------------------|
| Unit 1 | Understanding DNA <ol style="list-style-type: none"> Experimental evidences 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 & Singer experiment (TMV virus) Hershay & Chase experiment Types of nucleic acids (DNA and RNAs) 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 | 08 |

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| Unit 2 | Prokaryotic DNA replication <ol style="list-style-type: none"> 1. Models of DNA replication. (Conservative, semiconservative, and Dispersive) 2. Meselson and Stahl's experiment (semiconservative) 3. Enzymes, proteins and other factors involved in semi discontinuous DNA replication. 4. Modes of DNA replication- Rolling circle mechanism, theta and linear DNA replication | 07 |
| Unit 3 | Gene expression and mutations <ol style="list-style-type: none"> 1. Gene expression <ol style="list-style-type: none"> a. Concept of Genetic code and its properties b. Concept of transcription and translation 2. Mutations <ol style="list-style-type: none"> a. Concept of Mutation and Types of mutations: Nonsense, Missense, Silent, frame shift mutation b. Spontaneous Mutation <ol style="list-style-type: none"> i. Discovery of spontaneous mutation (Fluctuation test) ii. Mechanism of spontaneous mutation iii. Isolation of Mutants: Replica plate technique c. Concept of Induced Mutations <ol style="list-style-type: none"> i. Base pair substitution (Transitions, Transversions), Insertions and deletions- Frame /Phase shift mutations ii. Physical Mutagenic agents: UV and X ray iii. Chemical mutagenic agents: <ul style="list-style-type: none"> • Base analogues (2amino purine, 5bromo uracil), • HNO₂, Alkylating agents • Intercalating agents (EtBr, acridine orange) | 10 |
| Unit 4 | Plasmid genetics <ol style="list-style-type: none"> 1. Types of plasmids 2. Properties of Plasmid 3. Plasmid replication 4. Plasmid incompatibility 5. Plasmid curing | 05 |

Suggested Readings:

1. Bruce A. (2008), Molecular Biology of the Cell, 5th Edn. Publisher: Garland Science, New York.
2. David Freidfelder, (1987). Molecular Biology, 2nd Edn. Jones & Bartlett Pub.
3. .James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick, (2013), Molecular Biology of the Gene, 7th Edn. Pearson Publishers.
4. Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick, (2012) Lewin's GENES XI , 11th Edn. Jones & Bartlett Learning
5. Lodish H. et al. (2012), Molecular Cell Biology, 7th Edn. W. H. Freeman & Company. New York.
6. Primrose, S. B. (2002). Principles of Gene Manipulation 6th Edn. Oxford: Blackwell Scientific Publications
7. Russel Peter. (2009), Genetics: A Molecular Approach, 3rd Edn. Publisher Benjamin Cummings
8. Russel, Peter, (1990), Essential Genetics, 7th Edn. Blackwell Science Pub.
9. Stanier, R. Y. (1987), General Microbiology, 5th Edition, Macmillan Pub. Co. NY
10. Strickberger, M.W. (1985), Genetics, 3rd Edition Macmillan Pub. Co. NY.
11. R. J. Brooker, Genetics: analysis and principles, 6th edition, ISBN10: 1259616029 ISBN13: 9781259616020

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| Semester – IV | Paper – II |
| Course Code: BSC-MR 401 T | Title of the Course: Air, Water & Soil Microbiology |
| Credits: 02 | Total Lectures: 30 Hrs. |

Course Outcomes (COs):

- Students will understand the transient air flora, methods of air sampling and air sanitation and air borne infections
- Students will understand the types of water, Recommended Bacteriological standards of Water Quality, methods for Bacteriological analysis of water for potability, water purification methods, indicators of fecal pollution and water borne infections.
- Students will understand role of the rhizosphere microflora, large scale production of biofertilizer and biocontrol agents, microbial interactions in soil and role of microorganisms in humus and compost formation and in carbon, nitrogen, and Sulphur cycle.

Detailed Syllabus:

| Unit No. | Topic | No. of Hours |
|-----------------|--|---------------------|
| Unit 1 | Air Microbiology <ol style="list-style-type: none"> Air flora <ol style="list-style-type: none"> Transient nature of air flora Droplet, droplet nuclei, and aerosols Methods of Air sampling and types of air samplers <ol style="list-style-type: none"> Impaction on solids Impingement in liquid Sedimentation Centrifugation Air sanitation: Physical and chemical methods Air borne infections | 05 |
| Unit 2 | Water Microbiology <ol style="list-style-type: none"> Types of water: surface, ground, stored, distilled, mineral and de- mineralized water Recommended Bacteriological standards of Water | |

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| | <p>Quality of Maharashtra Pollution Control Board (MPCB) and Central Pollution Control Board(CPCB):</p> <ol style="list-style-type: none"> 3. Main Functions 4. Water quality standards for best designated usages 5. Water purification methods 6. Water borne Infections 7. Indicators of faecal pollution <p>(<i>Escherichia coli</i>, <i>Bifidobacterium</i>, <i>Streptococcus faecalis</i> <i>Clostridium perfringens</i>, New indicators: <i>Campylobacter</i> and <i>Pseudomonas</i>)</p> <ol style="list-style-type: none"> 8. Bacteriological analysis of water for potability a. Bacteriological standards of potable water: Bureau of Indian standards (BIS),World health Organization (WHO) b. Presumptive coliform count c. Confirmed test d. Completed test e. Eijkman test f. Membrane filter technique | 10 |
| Unit 3 | <p>Soil Microbiology</p> <ol style="list-style-type: none"> 1. Rhizosphere microflora and its role in the rhizosphere 2. Role of microorganisms in composting and humus formation 3. Biofertilizers: Bacterial, Cyanobacterial, fungal and their large-scale production 4. Biocontrol agents: Bacterial, Viral, Fungal and their large-scale production | 09 |
| Unit 4 | <p>1. Brief account of microbial interactions: Symbiosis, Neutralism, Commensalism, Competition, Ammensalism, Synergism, Parasitism, and Predation</p> <p>2. Role of microorganisms in elemental cycles in nature: Carbon, Nitrogen, Sulphur</p> | 06 |

Suggested Readings:

1. Subba Rao N. S. (1977) Soil Microbiology, 4th Ed., Oxford & IBH Publishing Co. Pvt. Ltd.
2. Dubey R.C., and Maheswari, D. K. Textbook of Microbiology, S. Chand & Co.
3. Martin A. (1977) An Introduction to Soil Microbiology. 2nd edition. John Wiley & Sons Inc. New York & London.
4. Dube H.C. and Bilgrami. K.S. (1976) Text book of modern pathology. Vikas publishing house. New Delhi.
5. Daniel Lim., Microbiology, 2nd Edition; McGraw-Hill Publication
6. Ingraham J.L. and Ingraham C.A. (2004) Introduction to Microbiology. 3rd Edition. Thomson Brooks / Cole.
7. Madigan M.T, Martinko J.M. (2006) Brock's Biology of Microorganisms. 11th Edition. Pearson Education Inc.
8. Salle A.J. (1971) Fundamental Principles of Bacteriology. 7th Edition. Tata MacGraw Publishing Co.
9. Tortora G.J., Funke B.R., Case C.L. (2006) Microbiology: An Introduction. 8th Edition.
10. Stanier R.Y. (1985) General Microbiology. 4th and 5th Edn Macmillan Pub. Co. NY
11. Pelzar M. J., Chan E. C. S., Krieg N. R.(1986) Microbiology. 5th Edition, McGraw-Hill Publication
12. Prescott, Lancing M., John, P. Harley and Donald, A. Klein (2006) Microbiology, 6th Edition, McGraw Hill Higher Education
13. Hans G. Schlegel (1993) General Microbiology, 8th Edition, Cambridge University Press
14. Martin Frobisher (1937) Fundamentals of Microbiology, 8th Edition, Saunders, Michigan University press
15. WHO guidelines for drinking water quality Volume I
16. <https://www.mpcb.gov.in/water-quality/standards-protocols/water-quality-standards>
17. <https://cpcb.nic.in/wqstandards/>

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| Semester – IV | Paper – III |
| Course Code: BSC-MR 403 P | Title of the Course: Practical Course based on Theory Paper I and II |
| Credits: 02 | Total Lectures: 60 Hrs. |

Course Outcomes (COs):

- Students will understand concept of diversity and able to calculate diversity index.
- Students will be able to analyze water sample and know the quality of drinking water or to know the potability of water by detecting the presence of indicator organisms, i.e. coliforms.
- Students will understand the various Physical and Chemical growth requirements of bacteria and able to draw bacterial growth curve.

Detailed Syllabus:

| Sr. No. | Title of the Experiment | No. of Practicals |
|----------------|---|--------------------------|
| 1. | Air sampling and 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 filtration technique (Demonstration) | 4 |
| 4. | Enrichment, Isolation and Preparation of Bioinoculant (Azotobacter/Rhizobium / Blue Green Algae (cyanobacteria)) | 2 |
| 5. | a. Induction of mutations by using physical mutagen (e.g. UV rays) b. Isolation of mutants by any suitable method c. Demonstration of UV survival curve | 3 |

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| 6. | Study of Bacterial growth curve | |
| 7. | Enumeration of bacteria from rhizosphere soil | 1 |
| 8. | Industrial visit | 1 |

Suggested Readings:

1. Harley, J.P. and Prescott, L.M., (2002). Laboratory Exercises in Microbiology, 5th Edition, The McGraw-Hill Companies.
2. Saravanan R., Dhachinamoorthi D., CH. M.M., Prasada Rao (2013). 1st Edition, A Handbook of Practical Microbiology, LAP LAMBERT Academic Publishing.
3. Goldman and E., Green H.L. (2015) Practical Handbook of Microbiology 3rd Edition, ,CRC Press.
4. Subhash Chandra Parija ,Practical Microbiology For Under Graduate Medical Students (2018), Ahuja Publishing House.
5. Dubey R.C. and Maheshwari D.K.,Practical Microbiology(2002),1st Edition, S.Chand Publication