

Date :- 29/06/2019


NOTIFICATION

Sub :- CBCS Syllabi of B. Sc./M. Sc. in Microbiology (Sem I & II)


Ref. :- Decision of the Academic Council at its meeting held on 28/06/2019.

The Syllabi of B. Sc./M. Sc. in Microbiology (First and Second Semesters) as per CBCS-UG/~~PG~~ Regulations, 2016 and approved by the Academic Council as referred above are hereby notified for implementation with effect from the academic year 2019-20.

Copy of the Syllabi shall be downloaded from the College Website (www.kcesmjcollege.in)


Chairman
Board of Studies




Principal,
M. J. College, Jalgaon

To :

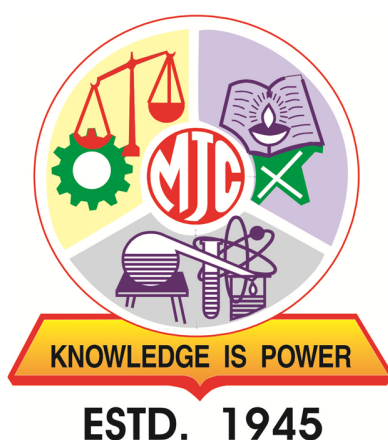
- 1) The Head of the Dept., M. J. College, Jalgaon.
- 2) The Director, School of Life Sciences, M. J. College, Jalgaon.
- 3) The office of the COE, M. J. College, Jalgaon.
- 4) The office of the Registrar, M. J. College, Jalgaon.
- 5) Office File.

Knowledge is Power

Khandesh College Education Society's

Moolji Jaitha College, Jalgaon

An "Autonomous College" Affiliated to
KBC North Maharashtra University, Jalgaon



SYLLABUS STRUCTURE OF

B. Sc. Microbiology

Under Choice Based Credit System (CBCS)

[w. e. f. Academic Year: 2019-20]

F. Y. B. Sc. Microbiology Course Structure

Term / Semester	Course Module	Subject code	Title of Paper	Credit	Hours per week
I	DSC	MB-111	Fundamentals of Microbiology	2	2
	DSC	MB-112	Microscopy and Basic Bacteriology	2	2
	DSC	MB-113	Methods in Basic Microbiology I	2	4
II	DSC	MB-121	Microbial ecology and Cytology	2	2
	DSC	MB-122	Microbial Techniques	2	2
	DSC	MB-123	Methods in Basic Microbiology II	2	4

S. Y. B. Sc. Microbiology Course Structure

Term / Semester	Course Module	Subject Code	Title of Paper	Credit	Hours per Week
III	DSC	MB-231	Fundamental Biochemistry	2	2
	DSC	MB-232	Microscopy and Basic Immunology	2	2
	DSC	MB-233	Methods in Biochemistry and Immunology	2	4
	SEC	MB-230	Microbial analysis of air, water and soil	2	2
IV	DSC	MB-241	Basic Genetics	2	2
	DSC	MB-242	Industrial Microbiology	2	2
	DSC	MB-243	Methods in Industrial and molecular biology	2	4
	SEC	MB-240	Food and dairy microbiology	2	2

T. Y. B. Sc. Microbiology Course Structure

Term / Semester	Course Module	Subject Code	Title of Paper	Credit	Hours per Week
V	DSE	MB-351	Microbial Genetics	2	2
	DSE	MB-352	Fermentation Technology	2	2
	DSE	MB-353	Microbial Metabolism	2	2
	DSE	MB-354	Medical Microbiology	2	2
	DSE	MB-355	Immunology	2	2
	DSE	MB-356	Applied microbiology	2	2
	DSE	MB-357	Techniques in Industrial Microbiology I	2	4
	DSE	MB-358	Techniques in Diagnostic microbiology I	2	4
	DSE	MB-359	Techniques in Applied Microbiology I	2	4
	SEC	MB-350	Microbial quality control	2	2
VI	DSE	MB-361	Molecular Biology	2	2
	DSE	MB-362	Pharmaceutical Microbiology	2	2
	DSE	MB-363	Enzymology	2	2
	DSE	MB-364	Clinical microbiology	2	2
	DSE	MB-365	Diagnostic immunology	2	2
	DSE	MB-366	Environmental Microbiology	2	2
	DSE	MB-367	Techniques in Industrial Microbiology II	2	4
	DSE	MB-368	Techniques in Diagnostic Microbiology II	2	4
	DSE	MB-369	Techniques in Applied Microbiology II	2	4
	SEC	MB-360	Biofertilizer and biopesticides	2	2

Examination Pattern for the all Courses (40:10)

Nature	Marks
External Marks	40
Internal Marks	10
Total Marks	50

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SYLLABUS

Microbiology

F.Y.B. Sc.

(Semester I & II)

Under Choice Based Credit System (CBCS)

[w. e. f. Academic Year: 2019-20]

Preamble

Skilled human resource is a prerequisite in the higher education and it is to be acquired thorough knowledge of theoretical concepts and hands-on laboratory methods of the subject. The syllabus has been prepared keeping in view the unique requirements of B.Sc. Microbiology students under CBCS Program. The contents have been drawn to accommodate the widening horizons of the Microbiology discipline and reflect the changing needs of the students. The detailed syllabus for each paper is appended with a list of suggested readings.

The degree of Bachelor of Science in Microbiology aims to introduce various aspects of Microbiology to the students. The program in Microbiology as one of the core subject is designed to cultivate a scientific attitude and interest towards the modern areas of Microbiology in particular. This will help the students to become critical and curious in their outlook. The courses are designed to impart the essential basics in Microbiology at the initial level of graduation. The basic courses are infused with current application in modern life sciences, and awareness on Microbiology and its influence in human life. The integration of various courses in the program is aimed to develop proficiency in the theory as well as practical experiments, common equipment, laboratory, along with the collection and interpretation and presentation of scientific data in proper manner. Beside this, the students will be equipped with knowledge in the newer areas of Microbiology and its application in medical science, agriculture, industry, proteomics, genomics, metabolomics, bioinformatics, nano-biotechnology etc. This will create zeal and zest about Microbiology which will pave a newer path for the development of society. At the end of the course, the students are expected to have good working knowledge in the field of Microbiology. Students will surely have an urge to continue higher studies in Microbiology and contribute significantly in the development. The core thrust is laid on making syllabus compatible with developments in Education, Research and Industrial sectors. The Theory and Practical course in new restructured course will lead to impart skill-set essentials to further microbiology.

Course Structure:

Duration : The duration of B.Sc. (Microbiology) degree program shall be three years.

Medium of instruction: The medium of instruction for the course shall be English.

The present syllabus has been prepared to

- (i) Accommodate the advanced topic on the Microbiology discipline,
- (ii) Build the basic science knowledge at the level of first year of Microbiology and
- (iii) Reflect the changing needs of the students. The detailed syllabus for each paper is appended with a list of suggested readings.

At first year of under-graduation, students are given exposure to basic science to build the foundation of advance Microbiology. For this purpose, more focus on relevant experimentation on the topics is included in practical course. In practical course, students will be trained in preparing laboratory manuals, standard operating practices and log books.

At second year under-graduation, students will be introduced to different areas necessary to form the basis of microbiology like genetics, immunology, enzymology, and bioprocess biotechnology. The relevant practicals are included to enrich their knowledge.

At third year under-graduation, six theory and three practical papers each for two semesters are included to uncover all applied areas of microbiology. The courses codes and titles for the courses are as given below:

MB 111: Fundamentals of Microbiology (Theory)

Total Hours: 30

Credits: 2

Course objective: To acquaint concepts of emerge of microbiology and basic concepts in microbial diversity

Learning outcome

Successful completion of this course students are expected to:

- How the subject emerge as new branch of biology and its current scope
- Aware about historical developments and contribution of various pioneers
- Understand the comparative characteristics of prokaryotes and eukaryotes
- Aware about diversity of microorganism and microbial taxonomy
- Understand the similarities and differences among various microbes

Unit I Historical developments and Scope of Microbiology (10 lectures)

- Concept of prokaryotic and eukaryotic cell, Discovery of virus
- Concept of Spontaneous generation (abiogenesis) and biogenesis.
- Discovery of Microscope
- Germ theory of Fermentation
- Germ theory of Disease: Koch's and Revere's postulate
- Development of pure culture methods, preparation of Decimal Dilution, solidifying agent
- Contribution(s) of: Antonie von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming, Martinus W. Beijerinck, Sergei N. Winogradsky, Selman A. Waksman, Paul Ehrlich, Elie Metchnikoff, Edward Jenner in the development of microbiology
- Microbiology and India: Contributions of researcher from Indian origin viz. Ananda Mohan Chakrabarty, Subba Rao, Natteri Veeraraghavan, Khem Shahani, R. Ananthanarayan etc.
- Research institutes/ industries in India related to Microbiology: NIV, MTCC, ARI, NEERI, Serum institute, HiMedia etc.
- Development and scope of microbiology in: Soil / Agricultural/ Geo / Environmental / Microbial Ecology / Food & Dairy Industrial / Pharmaceutical / Medical Microbiology/ Chemotherapy and Health/ Immunology/ Molecular Biology/ Bioinformatics and Nano-technology etc.

Unit II Microbial Diversity (10 lectures)

- Concept of microbial diversity, ecology and its importance and ecological interactions
- General characteristics, Morphological features and Significance:
 - Viruses, Virion and Prions
 - Bacteria (Eubacteria, Rickettsia, Mycoplasma, Actinomycetes,) and Cyanobacteria
 - Archae
 - Algae
 - Fungi
 - Protozoa

Unit III Microbial Taxonomy

(10 lectures)

- Whitakers' Five Kingdom system
- Carl Woese's three Domain system
- Binomial Nomenclature and basic rules
- Methods in Microbial Taxonomy: Cultural, Biochemical and Molecular Characteristics, Numerical taxonomy, Chemotaxonomy, Phylogenetic taxonomy, polyphasic approach
- Bergey's System of Bacterial Classification: structure, scheme and overview
- Introduction to classification of algae, fungi and viruses

Suggested reading

- Tortora GJ, Funke BR and Case CL (2008). Microbiology: An Introduction, 9th edition, Pearson Education, New Delhi
- Talaro K and Chess B (2012) Foundations in Microbiology, 8th edition, The McGraw-Hill Companies, Inc., New York
- Tortora, Funke, and Case (2010) Microbiology, 10th edition, Benjamin Cummings Inc., California.
- Ulhas Patil, JS Kulkarni, AB Chaudhari and SB Chincholkar (2016). Foundations in Microbiology, 9th edition, Nirali Prakashan, Pune
- Frobisher M. Hinsdill, Crabtree, and Goodheart, (1974). Fundamentals of Microbiology, 9th edition, WB Saunder's Co., USA.
- Dubey RC and Maheshwari DK (2005) Text Book of Microbiology, S Chand and Co, New Delhi

MB 112: Microscopy and Basic Bacteriology (Theory)

Total Hours: 30

Credits: 2

Course objective: To understand basic knowledge about microscopy and microbial growth

Learning outcome

Successful completion of this course students are expected to:

- Understand theory in microscopy, their handling techniques and staining procedures
- Know concept of growth, media of cultivation, quantitative measurement of bacterial growth
- Aware about types of bacterial cultures such as batch, continuous and synchronous
- Understand the modes of microbial nutrition and able to classify bacteria based on nutrition
- Know the various physical / chemical growth requirements of bacteria

Unit I Microscopy and staining

(10 lectures)

- Basics of Microscopy: Magnification, Resolution, Numerical Aperture, Illumination system.
- Bright field and Dark field Microscope
- Compound Microscope: Principle with Ray diagram, construction, lens systems, working
- Immersion oil and its use in compound microscope
- Care of microscope
- Concept and types of aberrations, correction for aberrations
- Concepts of Dyes and Stains, types of stain (Acidic, Neutral and Basic), Mordant and fixative

- Preparation and fixation of smear
- Methods of staining: Simple (Monochrome and Negative) and Differential (Gram and Acid fast)

Unit II Growth and Reproduction of Bacteria (10 lectures)

- Concept of Growth and Reproduction, Mechanism of binary fission, Fragmentation, budding
- Mathematical expression of Growth, Growth curve, Generation time and Growth rate (Illustration with problem).
- Batch culture and typical growth curve of bacterial population and its significance, Diauxic growth
- Quantitative measurement of bacterial growth: determination of cell number, cell mass and cell activity
- Synchronous and continuous culture growth with applications in microbiology

Unit III Cultivation of Bacteria (10 lectures)

- Physical parameters: pH, temperature, water activity, Oxygen
- Types of bacteria, mode of their adaptations with respect to
 - Temperature requirement (psychrophiles, mesophiles, thermophiles, thermodurics, psychrotrophs),
 - pH requirement (acidophiles, neutrophiles and alkaliphiles),
 - Salt/solute and water activity (halophiles, xerophiles, osmophilic),
 - Oxygen requirement (aerobic, anaerobic, microaerophilic, facultative aerobe, facultative anaerobe), Pressure (barophile).
- Major and Minor Elements of Nutrition and its significance:
 - Major Elements of Nutrition C, N, H₂O, S & P
 - Minor Elements of Nutrition: Salts, growth factors etc.
- Media ingredients (water, peptone, malt extract, meat extract, yeast extract, trace elements, growth factor)
- Types of media: complex, synthetic, natural, selective, differential, enriched media
- Enrichment culture technique
- Concept Auxotroph and Prototroph
- Classification of bacteria based on nutrition: Phototroph (Photo-autotroph, Photo-heterotroph) and Chemotroph (Chemo-autotroph, Chemo-heterotroph)

Suggested readings

- Wiley, JM, Sherwood, LM and Woolverton, CJ. (2013) Prescott's Microbiology. 9th Edition. McGraw Hill International, New York
- Frobisher M. Hinsdill, Crabtree and Goodheart (1974). Fundamentals of Microbiology, 9th edition, WB Saunder's Co. USA.
- Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms, 14th edition, Pearson International Edition, New Delhi
- Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company, New York
- Tortora, Funke and Case (2010). Microbiology, 10th edition, Benjamin Cummings Inc, California.
- Ulhas Patil, JS Kulkarni, AB Chaudhari and SB Chincholkar (2016). Foundations in Microbiology 9th edition, Nirali Prakashan, Pune
- Modi, H. A. (2014) Elementary Microbiology, Vol. 1 and 2, Akshar Prakashan, Ahmedabad

MB 113: Methods in Basic Microbiology I (Practical)

Total Hours: 60

Credits: 2

Course objective: To introduce various microorganisms present in the ecosystem and acquaint with common equipment used in routine microbiology laboratory

Learning outcome: After successful completion of this course students are expected to:

- Understand the basic microbial practices, instruments, appropriate protective and emergency procedures
 - Study the comparative characteristics of prokaryotes and eukaryotes
 - Analyse, interpret, document and report results from a variety of microbiological methods.
 - Demonstrate theory and practical skills in microscopy, staining procedures and growth
 - Comprehend the various methods for identification of microorganisms adopted in Bergey's manual and able to classify the bacteria
1. Microbiology Good Laboratory Practices, laboratory rules and first aids.
 2. To study the principle, working and application of instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter, Balance) used in the microbiology laboratory
 3. Acquainting basic microbiology techniques I: Types of laboratory glassware, Cleaning and washing of Glassware, biosafety measures, disinfection of working table and hands, biological waste Disposal, Use of Microbial culture and its storage
 4. Acquainting basic microbiology techniques II: Preparation of culture media for bacterial cultivation, Cotton Plugging, Wrapping the items prior to sterilization, sterilization with autoclave, Aseptic handling (LAF/Bunsen burner), preparation of plates and slants, Inoculation of bacterial culture and inoculating needle, labelling of incubation material, preservation.
 5. Use and Care of Compound Microscope with functions of each part
 6. Study of microbes with using temporary mounts / permanent slides
 - Fungus e.g.. *Rhizopus/ Penicillium/ Aspergillus/ Fusarium*
 - Algae/BGA e.g. *Spirogyra /Anabena / Nostoc/ Cyanobacteria*
 - Protozoans e.g. *Amoeba/Entamoeba/ Paramecium / Plasmodium*
 7. Study of colony characteristics of different bacteria (e.g. *Escherichia coli, Staphylococcus aureus, Actinomycetes*)
 8. Study of Biochemical characterization through IMViC test
 9. Study of biochemical characterization through TSI and Sugar fermentation
 10. Study of bacterial morphology using Monochrome staining
 11. Study of morphological features of bacteria using Negative Staining
 12. Study of Gram characteristics of bacteria using Gram's staining
 13. Study of acid fast characteristics of bacteria using Acid fast staining (*Nocardia spp/ Atypical mycobacteria*)
 14. Effect of pH on growth of bacteria
 15. Effect of temperature on growth of bacteria
 16. Demonstration of identification key adopted in: Bergey's Manuals of Systematic Bacteriology: structure, basis, scheme in general

Suggested readings

- Atlas, R. M. (1997) Principles of Microbiology, 2nd edition, W.M.T.Brown Publishers, Dubuque, USA.
- Cappucino J and Sherman N. (2010) Microbiology: A Laboratory Manual, 9th edition, Pearson Education Limited, New Delhi
- Parija S.C. (2005) Text Book of Practical Microbiology, 1st edition, Ahuja Publishing House, New Delhi.
- Dubey RC and Maheshwari DK (2004) Practical Microbiology, 1st edition, S. Chand and Co., Delhi.
- Harley, J. P. and Prescott L. M. (2002) Laboratory Exercises in Microbiology, 5th edition, The McGraw-Hill Co., New York
- Benson H. (2001) Microbiological Applications Lab Manual, 8th edition, The McGraw-Hill Companies, New York
- Aneja K.R. (1996) Experiments in Microbiology, 3rd edition, Wishwa Prakashan, New Delhi.

SEMESTER-II

MB 121: Microbial ecology and Cytology (Theory)

Total Hours: 30

Credits: 2

Course objective: To acquaint students with basic concepts in microbial ecology and cellular architecture

Learning outcome: After successful completion of this course students are expected to:

- Understand the basic microbial structure and function
- Study the comparative characteristics of prokaryotes and eukaryotes
- Understand the structural architecture and differences among bacteria/archaea
- Know basic knowledge pertinent to Microbial ecology and interactions

Unit I Microbial ecology (10 lectures)

- Concept of microbial ecology and types of microbial interactions
 - Positive and Negative: Mutualism, Cooperation, Commensalism, Predation, Ammensalism
- Concept, establishment (Direct and Re-infection) and importance of symbiosis
- Examples Microbial interactions:
 - Legume-rhizobium
 - Mycorrhiza
 - Lichen
 - Ruminant symbiosis
 - Bacterial bioluminescence

Unit II Anatomy of Prokaryotic cell (10 lectures)

- Ultra-structure of bacterial cell. Cell size, shape and arrangement,
- Structure, Function and Chemical Composition of: Glycocalyx/capsule, Flagella, endoflagella, Pilli, Cell wall, sphaeroplasts, protoplasts, and L-forms
- Cell Membrane: Structure, function and chemical composition of bacterial and archaeal cell
- Nucleolus, Nucleoid Mesosomes, Plasmid, phasmid, Ribosome, Cytoplasmic inclusions (volutin granules, PHB granule, glycogen, carbohydrates, Magnetosomes, gas vesicles, carboxysomes, chlorosome and sulphur granules).
- Endospore structure and formation

Unit II Anatomy of Eukaryotic cell (10 lectures)

- Ultra-structure of Fungal, Algal and Protozoal Cell
 - Structure, Function and Chemical Composition of: Flagella, Cell wall, Nucleus, Mitochondria, Chloroplast, Golgi bodies, Ribosome, Lysosome

Suggested readings

- Black, JG. (2008) Microbiology: Principles and Explorations, 7th edition, Prentice Hall, New Jersey.
- Madigan, MT and Martinko, JM. (2014). Brock Biology of Micro-organisms, 14th edition, Parker J. Prentice Hall International, Inc., New Jersey.
- Stanier, RY, Ingraham, JL, Wheelis, ML and Painter, PR. (2005) General Microbiology, 5th edition, McMillan, London

- Salle, S.J. (1974) Fundamental Principles of Bacteriology, 2nd edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
- Willey, JM, Sherwood, LM, and Woolverton, CJ. (2013) Prescott's Microbiology, 9th edition, McGraw Hill Higher Education, New Delhi.
- Patil, UK., Kulkarni, JS., Chaudhari, AB. And Chincholkar, SB. (2016) Foundation in Microbiology, 9th edition, Nirali Prakashan, Pune

MB 122: Microbial Techniques (Theory)

Total Hours: 30 **Credits: 2**

Course objective: To complement the students with cultivation and control of microbe

Learning outcome: After successful completion of this course students are expected to:

- Know microbial techniques for isolation of pure cultures of bacteria, fungi, algae and virus
- Demonstrate theory and practical skills in handling microbial culture
- Understand various physical and chemical means of control of microbes
- Understand various methods for sterilization
- Know about sterility assessment of sterilizing agents

Unit I Isolation and Cultivation of Microbes (10 lectures)

- Enrichment methods for bacteria (photoautotroph, photoheterotroph, chemoautotroph, chemoheterotroph)
- Pure culture technique for bacteria: Streak plate, Pour plate, Spread plate
- Cultivation of anaerobes: Roll tube method, anaerobic jar and anaerobic cabinet/chamber
- Cultivation of fungi, Blue green algae, algae
- Cultivation of animal and plant viruses (living animals, embryonated eggs and cell line cultures).
- Cultivation of bacteriophage

Unit II Concept of aseptic condition and disinfectant in control of microbes (10 lectures)

- Aseptic condition - necessity and application
- Disinfection: Concept of disinfectant and characteristic of an ideal disinfectant, Phenol coefficient (Rideal–Walker coefficient)
- Concept of: Antiseptic, Sanitizer, Germicide, Antibiotics, Microbiocide, Microbiostasis.
- Pasteurization (HTST, UHT)
- Control of microbes by Low Temperature, Desiccation, Osmotic pressure, Surface tension, chemical and biological agents
- Mode of action and applications of Phenol and Phenolic compounds, Alcohols, Halogens, Heavy metals and their compounds, Dyes, Detergents, Quaternary ammonium compounds, H₂O₂.

Unit III Control of Microbes by Sterilization (10 lectures)

- Concept of sterilization, parameters, TDT and TDR
- Concept of D, Z and F value

- Physical methods: Dry heat (Hot air oven, Incineration), Moist heat (Autoclave, Tyndallisation) and Radiation- (X-rays, Gamma rays and UV rays)
- Sterilization by Filtration: Membrane filter, LAF (HEPA), Nucleopore filters
- Chemical methods: Ethylene oxide and Formaldehyde
- Indicators of Sterilization: Chemical and Biological system
- Validation of sterility in autoclave and LAF

Suggested readings

- Pawar, CB, and Daginawala, HF. (1998) General Microbiology, Vol. I and II, 1st edition, Himalaya Publishing House, Mumbai.
- Black, JG. (2008) Microbiology: Principles and Explorations, 7th edition, Prentice Hall, New Jersey.
- Madigan, MT and Martinko, JM. (2014) Brock Biology of Micro-organisms, 14th edition, Parker J. Prentice Hall International, Inc., New Jersey.
- Frobisher, M. Hinsdill, R., Crabtree, KT., and Goodheart, CR. (1974) Fundamentals of Microbiology, 9th edition, WB Saunder's Co., Many, USA.
- Pelczar MJ, Chan, ECS and Krieg, NR. (1993) Microbiology. 5th edition. McGraw Hill Book Company, Penguin, USA
- Ulhas Patil, JS Kulkarni, AB Chaudhari and SB Chincholkar (2016) Foundations in Microbiology, 9th edition, Nirali Prakashan, Pune.
- Modi, H. A. (2014) Elementary Microbiology, Vol. 1 and 2, Akshar Prakashan, Ahmedabad

MB 123: Methods in Basic Microbiology-II (Practical)

Total Hours: 60

Credits: 2

Course objective: To instil practical skills about methods of isolation, characterization, control of microbes

Learning outcome: After successful completion of this course students are expected to:

- Introduce microbiology laboratory skills for advanced staining methods
 - Use pure culture and selective techniques to enrich and isolate microorganisms.
 - Understand the bacterial growth and comprehend various physical and chemical means of sterilization
 - Understand preparation of standard solutions required in various assays.
1. Study of motility of bacteria by hanging drop/ swarming growth
 2. Perform the Capsule staining
 3. Perform the Endospore staining
 4. Isolation of bacteria from enriched soil sample by Streak Plate technique
 5. Isolation of bacteria from water sample by spread plate technique
 6. Determination of Colony Forming Unit (cfu) by pour plate method from soil/water sample
 7. Effect of heavy metal(s) on growth of bacteria and demonstration of oligodynamic action
 8. Sterilization of heat sensitive material by membrane filtration
 9. Study micro-flora of the air using settling velocity

10. Microscopic observation of Rhizobacteria from root nodules/mycorrhizal spores from soil
11. Evaluation of skin disinfectant (alcohol/soap/Dettol) using Rideal–Walker coefficient
12. Slide culture technique for fungi
13. Preparation of standard solutions (Normal/ Molar/ Percentage)
14. Validation of autoclave using chemical/ biological indicator
15. Demonstration of bacterial growth by spectrophotometer

Suggested readings

- Atlas, R.M. (1997) Principles of Microbiology, 2nd edition, W.M.T. Brown Publishers,
- Cappucino J and Sherman N. (2010) Microbiology: A Laboratory Manual, 9th edition, Pearson Education Limited, New Jersey.
- Parija, S.C. (2005) Text Book of Practical Microbiology, 1st edition, Ahuja Publishing House, New Delhi.
- Harley, J. P. and Prescott, L. M. (2002) Laboratory Exercises in Microbiology, 5th edition, The McGraw-Hill Companies, London.
- Benson, H. (2001) Microbiological Applications Lab Manual, 8th edition, The McGraw-Hill Companies, New Delhi
- Aneja, K.R. (1996) Experiments in Microbiology, 3rd edition, Wishwa Prakashan, New Delhi.