

**MRSPTU M.SC. (MICROBIOLOGY) SYLLABUS BATCH 2021 ONWARDS
(2 YEARS COURSE)**

Total Credits = 29

| SEMESTER 1st | | Contact Hrs. | | | Marks | | | Credits |
|--------------------------------|-----------------------------------------|---------------------|----------|----------|--------------|-------------|--------------|----------------|
| Subject Code | Subject Name | L | T | P | Int. | Ext. | Total | |
| MMBLS1-101 | General Microbiology | 3 | 1 | 0 | 40 | 60 | 100 | 4 |
| MMBLS1-102 | Bacteriology | 3 | 1 | 0 | 40 | 60 | 100 | 4 |
| MMBLS1-103 | Virology | 3 | 1 | 0 | 40 | 60 | 100 | 4 |
| MMBLS1-104 | Mycology and Plant Pathology | 3 | 1 | 0 | 40 | 60 | 100 | 4 |
| MMBLS1-105 | Microbial Physiology & Biochemistry | 3 | 1 | 0 | 40 | 60 | 100 | 4 |
| MMBLS1-106 | Biostatistics | 3 | 1 | 0 | 40 | 60 | 100 | 4 |
| MMBLS1-107 | Microbiological Techniques-I Practical | 0 | 0 | 4 | 60 | 40 | 100 | 2 |
| MMBLS1-108 | Microbiological Techniques-II Practical | 0 | 0 | 6 | 60 | 40 | 100 | 3 |
| | Total | - | - | - | 360 | 440 | 800 | 29 |

Total Credits = 24

| SEMESTER 2nd | | Contact Hrs. | | | Marks | | | Credits |
|--------------------------------|----------------------------------------------------------------|---------------------|----------|----------|--------------|-------------|--------------|----------------|
| Subject Code | Subject Name | L | T | P | Int. | Ext. | Total | |
| MMBLS1-201 | Concepts in Immunology | 3 | 1 | 0 | 40 | 60 | 100 | 4 |
| MMBLS1-202 | Clinical & Medical Microbiology | 3 | 1 | 0 | 40 | 60 | 100 | 4 |
| MMBLS1-203 | Microbial Genetics | 3 | 1 | 0 | 40 | 60 | 100 | 4 |
| MMBLS1-204 | Molecular Biology and Genetic Engineering | 3 | 1 | 0 | 40 | 60 | 100 | 4 |
| MMBLS1-205 | Environmental Microbiology | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| MMBLS1-206 | Lab Techniques in Clinical Microbiology & Immunology Practical | 0 | 0 | 4 | 60 | 40 | 100 | 2 |
| MMBLS1-207 | Applied Microbiology Practical | 0 | 0 | 6 | 60 | 40 | 100 | 3 |
| | Total | - | - | - | 320 | 380 | 700 | 24 |

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Total Credits = 24

| SEMESTER 3rd | | Contact Hrs. | | | Marks | | | Credits |
|--------------------------------|---------------------------------------------|---------------------|----------|----------|--------------|-------------|--------------|----------------|
| Subject Code | Subject Name | L | T | P | Int. | Ext. | Total | |
| MMBLS1-301 | Food Microbiology | 3 | 1 | 0 | 40 | 60 | 100 | 4 |
| MMBLS1-302 | Environmental Biotechnology | 3 | 1 | 0 | 40 | 60 | 100 | 4 |
| MMBLS1-303 | Industrial Microbiology | 3 | 1 | 0 | 40 | 60 | 100 | 4 |
| MMBLS1-304 | Computer Applications | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| XXXXX | Open Elective*** | 3 | 1 | 0 | 40 | 60 | 100 | 4 |
| MMBLS1-305 | Food Microbiology Lab | 0 | 0 | 4 | 60 | 40 | 100 | 2 |
| MMBLS1-306 | Environmental & Industrial Microbiology Lab | 0 | 0 | 6 | 60 | 40 | 100 | 3 |
| | Total | - | - | - | 320 | 380 | 700 | 24 |

Total Credits = 23

| SEMESTER 4th | | Contact Hrs. | | | Marks | | | Credits |
|--------------------------------|-------------------------------------|---------------------|----------|----------|--------------|-------------|--------------|----------------|
| Subject Code | Subject Name | L | T | P | Int. | Ext. | Total | |
| MMBLS1-401 | Recent advances in Microbiology | 3 | 1 | 0 | 40 | 60 | 100 | 4 |
| MMBLS1-402 | Advances in Industrial Microbiology | 3 | 1 | 0 | 40 | 60 | 100 | 4 |
| YYYYY | Elective Course** | 3 | 1 | 0 | 40 | 60 | 100 | 4 |
| XXXXX | Open Elective*** | 3 | 1 | 0 | 40 | 60 | 100 | 4 |
| MMBLS1-403 | Advanced Practical in Microbiology | 0 | 0 | 6 | 60 | 40 | 100 | 3 |
| MMBLS1-404 | Research Assignment | 0 | 0 | 6 | 60 | 40 | 100 | 3 |
| MMBLS1-405 | Field Study | 0 | 0 | 2 | 60 | 40 | 100 | 1 |
| | Total | - | - | - | 340 | 360 | 700 | 23 |

**MRSPTU M.SC. (MICROBIOLOGY) SYLLABUS BATCH 2021 ONWARDS
(2 YEARS COURSE)**

* Based on seminars to be delivered by M.Sc. IVth semester students. Since each year the chosen topics will be different therefore no syllabus can be defined in sections. The exam of the above will be conducted internally.

**** Elective courses**

MMBLD1-411 Biochemical & Biophysical Techniques
MMBLD1-412 Waste Recycling

*****Open Elective Courses** will be selected from scheme of courses of other Departments.

Overall Marks / Credits

| Semester | Marks | Credits |
|-----------------|-------------|------------|
| 1 st | 800 | 29 |
| 2 nd | 700 | 24 |
| 3 rd | 700 | 24 |
| 4 th | 700 | 23 |
| Total | 2900 | 100 |

GENERAL MICROBIOLOGY

Subject Code: MMBLS1-101

**L T P C
3 1 0 4**

(Duration: 60hrs)

Course Objective:

To introduce to the students regarding various kinds of microbes in terms of their structure, growth & collection of clinical samples their processing and identification.

Course Outcomes:

Describe/explain the processes used by microorganisms for their replication, survival, and interaction with their environment, hosts, and host populations

Unit-1

15 hrs

Historical developments of microbiology, spontaneous generation theory, contribution of Leeuwenhoek, Pasteur, Koch, Needham, Lister, Winogradsky, etc., methods for isolation of pure culture, scope of microbiology.

Unit-2

15 hrs

Brief account of organization, classification of microorganisms. Differences between prokaryotic and eukaryotic cells. Cell cycle, mitosis, meiosis. Overview of bacterial cell structure, (size, shape, arrangement, membrane, cell wall, cytoplasmic inclusions, mesosomes, flagella and motility, slime, capsule, pili, chemotaxis, endospore).

Unit-3

15 hrs

Bacterial genome and its organization. Brief account of fungi, structure, physiology and classification. Brief account of viruses (bacteriophages) structure, life cycle (lytic and lysogenic). Reproduction and Growth: Life cycles of representative microorganisms including bacteria, fungi and viruses, population growth and its measurement,

Unit-4

8 hrs

Effect of environmental conditions on growth pH, temp. aeration etc, continuous culture, diauxic, synchronous growth cultures and anaerobic cultures. Control of microbes by physical and chemical agents. Antibiotics, properties and mode of action; Drug resistance and its significance. Antibiotic sensitivity test.

Unit-5

7 hrs

Industrial uses of bacteria, yeast & molds. Microscopy: Principles and applications in microbiology, brightfield microscopy, dark field microscopy, fluorescence and immunofluorescence microscopy, phase contrast and electron (transmission and scanning) microscopy. Staining of microorganisms.

Books Recommended:

- Stanier, R.Y. Adelberg, E.A. and Ingraham, J.L. (1984), General Microbiology, IV edn. Mac Millan Press.
- Pelczar, M.J. Chan, E.C.S. and Krieg, N.R. (1986), Microbiology, V Ed. McGraw Hill.
- Prescott. L.M. Harley J.P. and L. Kreig D.A. (1990). Microbiology, WCB Publishers.
- Rosenberg, E & Cohen I.R. (1983). Microbial Biology. H.S. International Editions

BACTERIOLOGY

Subject code: MMBLS1-102

**L T P C
3 1 0 4**

(Duration: 60hrs)

Course Objective:

This module gives detailed understanding about bacteria, its structure and growth conditions and the various factors affecting the growth of bacteria.

Course Outcomes:

Identify cell structures and its organization
The different methods of sterilization and isolation of pure cultures
Explain growth and reproduction in bacteria
Classify bacteria based on specific characteristics

Unit-1

15 hrs

General characteristics of bacteria. Bacterial growth, Synchronous growth, Continuous culture
Measurement of growth, Cell division and reproduction.

Unit-2

15 hrs

The Archaea and Deeply Branching Phototrophic Bacteria: Domain Archaea; Methanogens, Thermoplasmas, Extremely Thermophilic sulphur metabolizers.

Unit-3

15 hrs

Domain Bacteria; The Deinococci and Nonproteobacteria Gram Negatives: Aquificales and Thermotogae, Deinococcus- Thermus, Photosynthetic Bacteria: Chloroflexi, Chlorobi, and Cyanobacteria.

Unit-4

5 hrs

Phyla Planctomycetes, Chlamydiae, Spirochaetes and Bacteroidetes. The Proteobacteria; α -proteobacteria, β -proteobacteria, γ -proteobacteria, δ -proteobacteria and ϵ -proteobacteria.

Unit-5

10 hrs

The low G+C Gram Positive Bacteria: Clostridia, Mollicutes, Bacilli. The high G+C Gram Positive Bacteria; Actinobacteria, Planctomycetes, Spirochetes, Fibrobacters, Bacteroides, Fusobacteria.

Books Recommended:

- Holt, J.G., Krieg, N.R., Snodgrass, P.H.A., Atalay, J.T. and Williams, S.T. (Eds) Bergey's Manual of Determinative Bacteriology, 9th Edition (William R. Hensley Ed)
- Davis, B.D., DeLorenzo, R. Eisen, H.N. Ginsberg, H.S. and Wood, W.B. Jr. Microbiology, Harper & Row, 2006
- Stanier, R.Y., Ingraham, J.L. Wheelis, M.L. and Painter, P.R.. General Microbiology, Mac. Millan Press Ltd. U.K., 2005
- Prescott, L.M., Harley, J.P. and Klein, D.A. Microbiology 6th Edition, McGraw Hill, London (2005).
- Willey, J.M., Sherwood, L.M. and Woolverton, C.J. Prescott's Microbiology 9th Edition, McGraw Hill Education, (2014).

VIROLOGY

Subject code: MMBLS1-103

**L T P C
3 1 0 4**

(Duration: 60 hrs)

Course Objective:

The objective of this course is to give an exhaustive account of viruses, their structure, classification, replication and diseases associated with them, and their prevention and control methods. The course also deals with various applications of virology.

Course Outcomes:

Learn about diseases caused by medically important viruses, samples collection and laboratory diagnosis of some important viral infections.

Unit-1

15 hrs

Historical account and development of virology. General characteristics, envelope, capsid, nucleic acid & classifications of animal & bacterial viruses. One step growth curve of phages,

Unit-2

15 hrs

Isolation & purification of viruses. Cytopathic effects of virus infection. Assays of viruses, biophysical properties of viruses and point, thermal inactivation, dilution end point, longevity in-vitro, virus culture.

Unit-3

15 hrs

Chloroplast agglutination, haemagglutination, serological & molecular based detection of viruses. Attachment and entry of enveloped and non-enveloped animal viruses, Replication strategies of animal viruses,

Unit-4

5 hrs

Insect Transmission of plant viruses, Role of viruses in genetic engineering. Brief concept of viroids and prions. Viral diseases of plants (papaya, banana, tomato): symptoms, transmission, virus & control.

Unit-5

10hrs

Viral diseases of animals (Ranikhet disease of poultry farm, foot & mouth disease of cattle, bird flu & SARS). Clinical symptoms, pathophysiology, diagnosis and control of viral diseases in humans (Influenza, hepatitis, polio, Zika, Dengue, AIDS)

Books Recommended:

- Cann, Allanj. 1997. Principles of Molecular Virology, Academic Press London.
- Mathews REF 1998. Plant Virology, Academic Press, London.
- Viruses & Mycoplasma diseases in India, Raychandri, S.P. & Nariani, T.R. 1994. Malhotra Publishing House. New Delhi.
- N. Dimmock, A. Earton and K. Leppard : Introduction to Modern Virology, Blackwell Publishing (2007)
- E.K. Wagner and M.J. Hewlet. Basic virology (2nd Edn) Blackwell publishing (2004)

MYCOLOGY AND PLANT PATHOLOGY

Subject code: MMBLS1-104

**L T P C
3 1 0 4**

(Duration: 60hrs)

Course Objective:

This gives us detailed knowledge about the growth, lifecycle and metabolism of microbes in plant.

Course Outcomes:

detailed knowledge about morphology of microbes, mycology, parasitic disease associated in plants.

Unit-1

15hrs

Introduction, history, thallus organization, cell structure, Mode of nutrition, nutrient requirements of fungi, sexual (methods of plasmogamy) and asexual reproduction, fungal hormones, heterothallism, parasexuality in fungi.

Unit-2

15hrs

Brief account of systems of classification. Distinguishing characters and general life cycles of Oomycota (Saprolegniales), Zygomycota (Mucorales), Ascomycota (development of ascus; ascocarps), Basidiomycota & Deuteromycota. Origin and Phylogeny of fungal kingdoms.

Unit-3

15hrs

Fungal diseases of plants: Symptoms, transmission and control measures (biological, chemical, regulatory, physical). Rust and loose smut of wheat, red rot of sugarcane, late blight of potato, ergot of rye.

Unit-4

10hrs

Physiological responses of plants to pathogen: effect on respiration, photosynthesis, translocation of nutrients and water. Economic importance of fungi: Role of fungi in biodegradation, biodeterioration, medicine, food industry, enzyme production, biological control & mushroom production.

Unit-5

5hrs

Fungi as symbionts: Mycorrhizal associations-ectomycorrhiza, endomycorrhiza & ectendotrophic mycorrhiza; Lichens: thallus organization, economic importance.

Books Recommended:

- Alexopolous, C.J. and Mims, C.W., Blackwell, M (1996). Introductory mycology. IV edn., John Wiley and Sons inc., New York.
- Mehrotra, R.S. and K.R. Aneja. (2015). An introduction to Mycology. New Age International publishers.
- Agriose, G.N. 2005, Plant Pathology, 5th edition Publisher: Academic Press.
- Carlile, M.J. Watkinson, S.C. and Gooday, G.W. (2001) The Fungi. Publisher: Academic Press.
- Singh, R.S. (2009) Plant diseases. Oxford and IBH publishing company, New Delhi.
- Moore and Landecker. (1972) Fundamentals of the fungi. Publisher: Prentice Hall

MICROBIAL PHYSIOLOGY AND BIOCHEMISTRY

Subject code: MMBLS1-105

**L T P C
3 1 0 4**

(Duration: 60hrs)

Course Objective:

Students will be able to learn the terminology of the subject and knowledge of cell division, growth and metabolism of microorganism.

Course Outcome:

Describe the different level in prokaryotic and eukaryotic cells.

Explain the nutrition classification in the microorganism.

Unit-1

15hrs

Scope of studies on physiology and metabolism of microorganisms. Differences in level of organization of eukaryotic and prokaryotic cells, Biochemical components of microbial cell, Structure and function of different organelles (cell wall, cell membrane, capsule, flagella, pili/fimbriae, mitochondria, chloroplast, inclusion bodies, golgi apparatus, endoplasmic reticulum etc.).

Unit-2

15hrs

Modes of nutrition, classification of microorganisms on the basis of energy and carbon source requirements. Role of vitamins and growth factors. Growth of microorganisms, phases of growth, parameters for measuring growth. Factors (pH, temperature, availability of oxygen and osmolarity of medium) affecting growth of microorganisms.

Unit-3

15hrs

Brief account of cell division in Gm-ve and Gm+ve cocci/rods, Resting forms in microorganisms, Endospore formation and its regeneration, salient genetic and biochemical events involved in endospore formation. Bioenergetics, basic concepts, redox pairs in energy productions, substrate level, oxidative and photo phosphorylations, chemiosmosis and components of ETC.

Unit-4

10hrs

Intermediary metabolism of carbohydrates (Important pathways for breakdown of glucose), formation of precursors and reducing power. Nitrogen assimilation and Control of glutamine synthetase, Nitrogen fixation; components involved and their interaction with general nitrogen regulation (Ntr system) Biosynthesis of cell wall, nucleotides and amino acids. General account of control of branched anabolic pathways

Unit-5

5hrs

Groups of microorganisms with C1 metabolic systems, General properties of Archaeobacteria, Salient features and differences from eubacteria and eukaryotes. Brief account of physiology of thermophiles, halophiles and methanogens. Methanogenesis

Books Recommended:

- Conn E.E. & Stumpf, P.K. (1988), Outline of Biochemistry John Wiley & Sons.
- Gottschalk, E. (2006). Microbial Metabolism Springer Verlag.
- Moat, A. and Foster, J.W. 2006 Microbial Physiology. 4th edition, Wiley-Liss.
- Edwards, Clive, 1990. Microbiology of Extreme Environments. Mc Graw Publishing.

BIostatISTICS

Subject code: MMBLS1-106

**L T P C
3 1 0 4**

(Duration: 60hrs)

Course Objective:

To learn the various statistical methods used for the collection of the data.

Course Outcome:

Students will be able to learn hypothesis, probability, various methods of hypothesis testing and analysis of variance.

Unit-1

15hrs

Statistical Methods — Collection of data, Frequency distribution and, Measures of Central Tendency, Dispersion.

Correlation and Regression — Relationship between variables, Covariance, Karl-Pearson's Correlation Coefficient, Spearman's rank Correlation Coefficient, Least square technique for regression lines (without proof), Regression Coefficients, Relationship between Correlation analysis and Regression Analysis.

Unit-2

15hrs

Probability — Mathematical definition of probability of an event, Use of permutations and combinations in calculations of Probability, Conditional probability, Additive and Multiplication law of Probability, Random Variables and its pmf, pdf, cdf, Mathematical expectation and variances, Theoretical Distributions: Binomial, Poisson and normal, Properties of these distributions (applications only).

Unit-3

15hrs

Hypothesis Testing — Sample, Population, Statistics and Parameters, Null Hypothesis, Level of significance, Definitions of Chi-square, 't' and 'F' variates and their pdfs only, Applications of these distributions in testing of hypothesis.

Unit-4

10 hrs

Large sample test- Testing of significance of proportion in single population, Testing of equality of proportions in two populations, Testing of significance of mean in single population, Testing of equality of means in two populations.

Unit-5

5 hrs

Analysis of Variance — Meaning of analysis variance with linear models, Analysis of variance for one-way classified data, Analysis of variance for two-way classified data with one observation for cell.

Reference Books:

- Bland, M. (2006). An Introduction to Medical Statistics. Oxford University Press, 3rd ed.
- Finney, D.J. (1980). Statistics for Biologists. Chapman and Hall Ltd.
- Hoel, P.G. (1971). Elementary Statistics. John Wiley and Sons, 3rd ed.
- Ross, S.M. (2005). Introductory Statistics. Academic Press, 2nd ed.
- Wayne, W, Daniel (1999). Biostatistics: A Foundation for Analysis in Health Sciences. John Wiley and Sons, 7th ed.
- Woodworth, G. (2004). Biostatistics: A Bayesian Introduction. John Wiley and Sons.

MICROBIOLOGICAL TECHNIQUES-I (PRACTICAL)

Subject code: MMBLS1-107

L T P C
0 0 4 2

Duration: 4hrs/week

Practical

- Study of typical compound microscope
- Micrometry – measurement of a fungal spore
- Determination of cell density by counting chamber
- Isolation of bacteria from soil, air and water
- Isolation of fungi from soil
- Contact slide technique
- Streak and Pour plate techniques
- Development of a single colony of a bacterium

MICROBIOLOGICAL TECHNIQUES-II (PRACTICAL)

Subject code: MMBLS1-108

L T P C
0 0 6 3

(Duration: 6 hrs/week)

Practical

- Preservation of microorganisms, Subculturing on agar slants Preservation in soil preservation by overlaying cultures with mineral oil Preservation in glycerol stocks
- Stab culturing technique for motility demonstration
- Hanging drop technique
- Simple staining of a bacterium
- Negative staining of a bacterium
- Gram staining – Positive and negative