

॥ अंतरी पेटयू ज्ञानज्योत ॥



**NORTH MAHARASHTRA UNIVERSITY,
JALGAON.**

Syllabus for M.Sc.(Part-I)

MICROBIOLOGY.

(W.e.f. Acd. Yr. 2002 - 2003)

Syllabus for M.Sc. (Part-I) MICROBIOLOGY.

(W.e.f. Acad. Yr. 2002 - 2003)

STRUCTURE

Semester - I

MB-101	:	Mycology, Phycology and Virology
MB-102	:	Microbial Genetics
MB-103	:	Bioenergetics and Intermediary Metabolism
MB-104	:	Laboratory Course - I
MB-105	:	Laboratory Course - II

Semester - II

MB-201	:	Advanced Enzymology
MB-202	:	Biotechniques
MB-203	:	Biostatistics and Extremophile Microbiology
MB-204	:	Laboratory Course - I
MB-205	:	Laboratory Course - II

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MB-101 : Mycology, Phycology and Virology

- An Introduction to Fungi : General features of fungi, Classification of fungi, Life cycle of selected fungi (*Aspergillus*, *Penicillium*, *Yeasts*)
 - Structure of Fungal Cells and Growth : Hyphae and non-motile unicells, motile cells, spores, dormancy, growth of population and colonies, effect of environment on growth, prevention of fungal growth.
 - Phycology : Distribution of algae, classification of algae, algal nutrition, algal thallus, algal reproduction, green algae, diatoms, euglenoids, brown Rhodophyta, Pyrrophyta, Algal ecology and algal Biotechnology.
 - General Virology : Brief outline on discovery of viruses, nomenclature and classification of viruses, distinctive properties of viruses, morphology and ultra-structure, capsids and their arrangements, types of envelopes and their composition, viral genome, their types and structures, virus related agents (viroids and prions).
 - General methods of viral diagnosis : Cultivation of viruses in embryonated eggs, experimental animals and cell cultures, primary and secondary cell cultures, suspension cell cultures and monolayer cell cultures, cells strains, cell lines and transgenic systems, infectivity assay (Plaque method and point method)- infectivity assay of plant viruses.
 - Bacterial Viruses : Bacteriophage structural organization, life cycle, one step growth curve, transcription, DNA replication, eclipse phase, phage production, burst size, lysogenic cycle, brief details on T4, lambda and P1.
- Plant viruses : Classification and nomenclature; effects of viruses on plants; appearance of plants; histology, physiology and cytology of plants; common viral diseases of plants : paddy, cotton, tomato and sugarcane; life cycle; type species of plant viruses like TMV, Cauliflower Mosaic Virus and Potato Virus X; indicator plants.
- Animal viruses : Classification and nomenclature of animal human viruses, epidemiology, life cycle, pathogenicity of RNA viruses : Picorna, toga, Rhabdo and HIV, DNA viruses - SV 40, Hepatitis, interferons and anti-viral drugs.

Books and References

- 1) Burnett, J.H. Fundamentals of Mycology. Publisher : Edward, Arnold Crane Russak
- 2) Charlile, N. and Watkinson, S.C. The fungi, Publisher : Academic Press
- 3) Moore, E. Fundamentals of Fung, - Landecker, Publisher : Prentice Hall
- 4) Alexopoulos C.I. & C.W. Mims, (1979). Introduction to mycology (IIIrd Edn.), Wiley Eastern Ltd., New Delhi.
- 5) Mehrotra, R.S. & K.R. Anuja, (1990). An introduction to mycology, New Age International Publishers.
- 6) Morag C. & Timbury, M.C. (1990). Medical virology (Xth Edn) Churchill Livingstone, London.
- 7) Dimmock, N.J., Primrose, S.B. (1994). Introduction to modern virology (IVth Edn), Blackwell Scientific Publications, Oxford.
- 8) Conrat H.F., Kimball, P.C. and Levy, J.A. (1994). Virology, (IIrd Edn), Prentice Hall, Englewood Cliff, New Jersey.
- 9) Mathews, R.E. (1992). Functionals of plant virology, Academic Press, San Diego.
- 10) Topley and Wilsons' (1995) Text book on principles of bacteriology, virology and immunology. Edward Arnold London.
- 11) Lennetter, F.H. (1984) Diagnostic procedures for viral and rickettsial diseases. American Public Health Association, N.Y.

- 12) William Hayes (1985) The genetics of bacteria and their viruses. Blackwell Scientific Publishers, London.
- 13) Griffin, D.H. (1994) Fungal Physiology, 2nd edn. Wiley-Liss, New York.
- 14) Smith and Berry (Eds.) Fungal Biotechnology, Vol. IV, Filamentous fungi series.
- 15) Venkataraman, L.V. and Becker, E.W. (1985) Biotechnology and utilization of algae. The Indian Experience.
- 16) Becker, E.W. (1994) Microalgae - Biotechnology and Microbiology, Cambridge Univ. Press.

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MB-102 : Microbial Genetics

- Gene as unit of mutation and recombination : Molecular nature of mutations, mutagens. Spontaneous mutations-origin.
- Gene transfer mechanisms-transformation, transduction, conjugation and transfection. Mechanisms and applications. Genetic analysis of microbes. Bacteria and yeast.
- Plasmids, Properties, Nomenclature and Classification. F-factors description and their uses in genetic analysis. Colicins and col factors. Plasmids as vectors for gene cloning. Replication of selected plasmids. compatibility. Transposons and their uses in genetic analysis.
- Bacteriophages, Lytic phages - T7 and T4. Lysogenic phages P1, M13 and EX174. Life cycle, and their uses in microbial genetics.
- Microbial genetics and design of vaccines. BCG and design of vaccine for TB and leprosy. DNA vaccines, design and advantages.

Books and References

1. Mafoy et al. (1994). Microbial Genetics. Jones & Bartlett Publishers, London.
2. J.W. Dale (1994). Molecular genetics of bacteria. John Wiley & Sons.
3. Streips & Yasbin. (1991) Modern microbial genetics. Niley. Ltd.

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MB-103 : Bioenergetics and Intermediary Metabolism

- Bioenergetics : Energy transformation. Laws of thermodynamics, entropy, enthalpy, Gibbs energy, free energy changes and redox potentials, Phosphate potential, Uniport, antiport and symport mechanisms, shuttle systems.
- The mitochondrial respiratory chain order and organization of carriers, proton gradient, iron sulphur proteins, cytochromes and their characterization. The Q cycle and the stoichiometry of proton extrusion and uptake; P/C and H/P ratios. Reversed electron transfer, respiratory controls and oxidative phosphorylation, uncouplers and inhibitors of energy transfer. Fractionation and reconstitution of respiratory chain complexes.
- ATP - Synthetase complex, Microsomal electron transport, partial reduction of oxygen, superoxides.

Intermediary metabolism : Approaches for studying metabolism.

- **Carbohydrates :** Glycolysis, citric acid cycle its function in energy generation and biosynthesis of energy rich bonds, pentose phosphate pathway and its regulation. Alternate pathways of carbohydrate metabolism.
Gluconeogenesis, interconversions of sugars. Biosynthesis of glycogen, starch and oligosaccharides. Regulation of blood glucose homeostasis. Hormonal regulation of carbohydrate metabolism.
- **Lipids :** Fatty acid biosynthesis : Acetyl CoA carboxylase, Fatty acid synthase, desaturase and elongase. Fatty acid oxidation : α , β , ω oxidation and lipoxidation. Lipid Biosynthesis : Biosynthesis of triacylglycerols, phosphoglycerides, Ketone bodies : Formation and utilization, Metabolism of Circulating lipids : chylomicrons LDL, HDL and VLDL. Free fatty acids. Lipid levels in pathological conditions.
- **Amino Acids :** Biosynthesis and degradation of amino acids and their regulation. Specific aspects of amino acid metabolism. Urea cycle and its regulation. In-born errors of amino acid metabolism.
- **Nucleic Acids :** Biosynthesis of purines and pyrimidines. Regulation of purine and pyrimidine biosynthesis. Degradation of purines and pyrimidines. Structure and regulation of ribonucleotide reductase. Biosynthesis of ribonucleotides, deoxyribonucleotides and polynucleotides. Inhibitors of nucleic acid biosynthesis

Books and References

1. Lehninger's Principles of Biochemistry (2000) 1st Edition by D.L. Nelson and M.M. Cox, Mcmillan Worth Pub. Inc. N.Y.
2. Biochemistry (1992) 4th Edition by Lubert Stryer, W.H. Freeman and Co., N.Y.
3. Harpers' Biochemistry, 25th Edition by R.K. Murray & Others, Appleton and Lange, Stamford.
4. Doelle, H.W. (1975) Bacterial Metabolism, 1st edn., Academic Press, Inc., N.Y.

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MB-104 : Laboratory Course-I

- Introduction to safe laboratory practices, first aid, hazardous/inflammable chemicals, antidotes to toxic chemicals; care and handling of glassware, instruments, planning, execution and recording of data.
- Concept of buffers, pH, pK, molarity, normality
- Amino acids separation and identification by paper chromatography
- Estimation of amino acids by ninhydrin method
- Estimation of protein by Lowry/Biuret method
- Acid, alkaline and enzymatic hydrolysis of protein and their evaluation by gel filtration
- Carbohydrate separation and identification by thin layer chromatography
- Estimation of reducing sugars by DNSA method
- Total carbohydrates estimation by phenol sulphuric acid method

- Vitamin C estimation
- Colorimetric estimation of cholesterol
- Estimation of inorganic phosphate
- Preparation of egg albumin, milk casein, cystine and starch

Books and References

1. D. Plummer : An Introduction to Practical Biochemistry, Tata McGraw Hill Publisher.
2. J. Jayaraman : Laboratory manual in Biochemistry, New Age International Publisher.
3. S. Sadasivam & A. Manikam : Methods in Agriculture Biochemistry, Wiley Eastern Ltd., New Delhi.

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MB-105 : Laboratory Course-II

- Single colony isolation and checking genetic markers (genotype and phenotype)
- One step growth curve of bacteriophage T4
- Spontaneous and induced mutation : Isolation of antibiotic resistant mutants, auxotrophic mutants and Reversion of auxotrophs.
- Selective enrichment of auxotrophic and antibiotic (tet^r) mutant
- Bacterial conjugation
- Bacterial transformation
- Growth curve of fungi Yeast
- Study of mutations by Ames test
- Algal cultivation
- Slide culture cultivation of yeast, fungi
- Vit E production by *Spirulina*
- Detection and estimation of aflatoxin
- Bacteriocin production
- Plasmid curing by Physical method (elevated growth temperature)

Books and References

1. Harley, J.P. and Prescott, L.M. (1996) Laboratory Exercises in Microbiology, IIIrd edn., WBC McGraw Hill, New York.
2. Hudson, B.K. and Sherwood, L. (1997) Explorations in Microbiology : A discovery based approach, Prentice Hall, New Jersey.

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MB -201 : Advanced Enzymology

- Review of unisubstrate enzyme kinetics and factors affecting the rates of enzyme catalyzed reactions. Michaelis pH functions and their significance.
- Classification of multisubstrate reactions with examples of each class. Kinetics of multisubstrate reactions. Derivation of the rate of expression for Ping Pong and ordered Bi Bi reaction mechanism. Use of initial velocity, inhibition and exchange studies to differentiate between multisubstrate reaction mechanisms.
- Methods of examining enzyme-substrate complexes.
- Methods for measuring kinetic and rate constants of enzymic reactions and their magnitudes.
- Enzymes Turnover and methods employed to measure Turnover of enzymes. Significance of enzymes Turnover.
- Allosteric enzymes. Sigmoidal kinetics and their physiological significance. Symmetric and sequential modes for action of allosteric enzymes and their significance.
- Immobilized enzymes and their industrial application.
- Multienzyme system : Occurrence, isolation and their properties. Polygenic nature of multienzyme systems. Mechanism of action and regulation of pyruvate dehydrogenase and fatty acid synthetase complexes. Immobilized Multienzyme Systems and their applications.
- Co-enzymes and cofactors : Water soluble vitamins and their coenzymes. Metalloenzymes.
- Detailed Mechanisms of Catalysis of serine proteases Ribonuclease Chymotrypsin.
- Enzyme regulation, General mechanisms of enzyme regulation : Feed Back Inhibition and Feed forward stimulation; Enzyme repression, induction and degradation, control of enzymic activity by products and substrates; Reversible and irreversible covalent modifications of enzymes; Mono-cyclic and multi-cyclic cascade systems with specific examples.

Books and References

1. Price, N.C. and Stevens, L. (2000) Fundamentals of Enzymology. Oxford University Press, New York.
2. Dixon, M., Webb, E.C., Throne, C.J.R. and Tipton, K.F. Enzymes. Academic Press, New York.
3. Nelson, D.L. and Cox, M.M. (2000) Lehningers' Principles of Biochemistry, IInd Edn., Macmillan Worth Pub. Inc. N.Y.
4. Lubert Stryer (1992) Biochemistry, IVth Edn., W.H.Freeman and Co., N.Y.

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MB - 202 : Biotechniques

- Principles of buffer and pH meter (calculation of molarity)
- Chromatographs . adsorption, paper (PC), thin layer (TLC), ion exchange, high pressure (HPLC) and gas liquid (GLC) and affinity chromatography.
- Application of each chromatography technique in Biological Sciences
- Principles (Beer's law), methodology and applications of UV and visible spectroscopy (colorimetry and spectrophotometry).
- Colorimetry with respect to determination of reducing sugars, proteins and phosphate.
- Dialysis and electrodialysis, filtration and ultrafiltration, factors governing the choice of membranes.
- Electrophoresis, principles, types, parameters affecting electrophoretic separation, gradient electrophoresis and iso-electrofocussing, peptide mapping.
- Principles of microscopy, transmission electron microscopy (TEM), scanning electron microscopy (SEM).
- Principles and applications of lyophilization and Laminar air flow benches
- Principles and applications of centrifugation to biological systems. Basket centrifugation, density gradient centrifugation.
- Principles and applications of IR, NMR, atomic absorption spectroscopy, X-ray diffraction techniques.

Books and References

1. Friefelder, D. (1983) Physical Biochemistry, IInd edn., WH Freeman & Co., USA.
2. Holmes, D. and Peck H. Analytical Biochemistry.
3. Van Holde K.E., (1985) Physical Biochemistry, IInd edn., Prentice Hall Inc., New Jersey.
4. Upadhye, Upadhye and Nath, Biophysical Chemistry. Himalaya Publishers, Nagpur.
5. Wilson, K. and Goulding K.H. A Biologists' Guide to Principles and Techniques of Practical Biochemistry. ELBS edn.

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MB - 203 A : Biostatistics

- Principles and practices of statistical methods in biological research.
- Samples and population.
- Basic statistics - averages, statistics of dispersion, coefficient of variation.
- Standard error.
- Confidence limits.
- Probability distribution (Binomial, Poisson and Normal).
- Tests of statistical significance.
- Simple correlation of regression.
- Analysis of variance.
- Examples of the above for clarity of concepts.

MB - 203 B : Extremophiles Microbiology

- Mechanisms and molecular aspects of adaptation
 - a. Acidophiles
 - b. Alkalophiles
 - c. Thermophiles
 - d. Barophiles
 - e. Osmophiles
 - f. Psychrophiles
- Halophiles : Membrane variation, electron transport.
- Applications of thermophiles and extreme-philles.

Books and References

1. S.C. Gupta : Fundamentals of Statistics, Himalaya Publishing House, New Delhi.
2. Khan : Biostatistics, Tata McGraw Hill Publishers.
3. Daniel, W.W. (1999) Biostatistics : A foundation for analysis in the health, 7th edn., John Wiley & Sons Inc., New York.
4. Johni, H.N. (2000) Extremophiles. Springer Verlag, New York.
5. Honkoshi, K. and Grant, W.D. (1998) Extremophiles - Microbial Life in Extreme Environments, Wiley-Liss, New York.
6. Kushner, D.J. (1978) Microbial Life in Extreme Environments, Academic Press, London.

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MB - 204 : Laboratory Course-I

- Purification of a typical enzyme.
- Effect of pH, temperature, activators and inhibitors on enzyme activity.
- Determination of activation energy of a typical enzyme catalyzed reactions (Arrhenius plot).
- Determination of specific activity and turn over no. of salivary amylase.
- Determination of K_m and V_{max} of amylase by Michaelis plot, double reciprocal plot/Eadie Hofstee plot.
- Immobilization of a typical enzyme.
- Stabilization of an enzyme as a function of temperature and storage duration.
- Isolation and enrichment of
 - a) Alkaliphiles
 - b) Acidophiles
 - c) Osmophiles

Books and References

1. An introduction to practical biochemistry - D. Plummer, Tata McGraw Hill Publishers.
2. A laboratory manual in biochemistry - J. Jayaraman - New Age International Publishers.
3. Sadashivan, S. and Manickam. Methods in Agricultural Biochemistry, Wiley Eastern Ltd., New Delhi.

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Syllabus For M.Sc. in Microbiology
MB - 205 A : Laboratory Course-II

- Separation of amino acids by paper chromatography.
- Paper electrophoresis.
- Agarose gel electrophoresis.
- Polyacrylamide gel electrophoresis.
- Separation of blue dextran by gel filtration.
- Verification of Beer's law and determination of λ_{max} . Absorption spectra.
- Demonstration - Lyophilizer, GC/HPLC/AA's.
- Carbohydrate separation by TLC.

MB – 205 B : Computer Applications

- Computer peripherals & hardware description : Computer system design, Recognition and spectrum of different components of a computer system and their respective usage I/O and storage devices.
- Operating systems : System and application software, CUI & GUI, DOS, Latest available windows, multitasking.
- Introduction of digital computer : Organization, low level and high level languages, binary number system.
- Flow charts and programming techniques.
- Introduction to programming in Turbo Basic and C, writing few programmes in basic & C.
- Introduction to data structures and database concepts, introduction to Internet and its applications.
- Introduction to MS-Office software, covering words processing, spreadsheets and presentation software.
- Introduction to sequence analysis software.

Books and References

1. Fielding, A. Computing for biologists.
2. Wood, E.L. Microcomputers in Biochemical Education.
3. Jayaram, J. A laboratory manual in Biochemistry, New Age International Publishers, New Delhi.
4. Salasivar, S. and Manikam, K. Methods in Agricultural Biochemistry, Wiley Eastern Ltd., New Delhi.

Note: Each theory course is to be completed in 50 lectures of 60 min duration each in one semester.

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