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UNIVERSITY OF MYSORE



Estd. 1916

No.AC.2(S)/507/12-13

VISHWAVIDYANILAYA KARYA SOUDHA
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MYSORE-570 005
Dated: 01-06-2013.

NOTIFICATION

Sub: Revision of syllabus pattern of M.Sc. in Microbiology.

- Ref:** 1. Proceedings of Faculty of Science & Technology Meeting held on 21-02-2013.
2. Proceedings of the Meeting of Academic Council held on 27-03-2013.

The Board of Studies in **Microbiology (PG)** at its meeting held on 27-12-2012 has unanimously resolved to Revise the pattern of syllabus in M.Sc.in Microbiology from the academic year 2013-14.

The Faculty of Science and Technology and the Academic Council at their meetings held on 21-02-2013 and 27-03-2013 respectively approved the above proposals and the same is hereby notified.

The copy of revised syllabus of M.Sc.Microbiology is annexed herewith.

J. S. Srinivas
31/6/13
REGISTRAR.

To

1. The Registrar (Evaluation), University of Mysore, Mysore.
2. The Chairperson, BOS/DOS in Microbiology, MGM.
3. The Dean, Faculty of Science & Technology, DOS in Zoology, MGM.
4. The Deputy/Assistant Registrar (Evaluation), University of Mysore, Mysore.
5. Sri Narasimha Murthy, Statistician, E.B. UOM, Mysore.
6. The Supdt. AC.1 & AC.2, A.B., Academic Section, UOM., Mysore.
7. The P.A. to the Vice-Chancellor/Registrar/Registrar (Evaluation), UOM., Mysore.
8. The Case Worker, AC.7, Academic Section, University of Mysore, Mysore.
9. The Section Guard File(Supdt.AC.2), A.B., A.C., UOM.
10. The Schedule File.

AC2.Eng.25-4.R

UNIVERSITY



OF MYSORE

M. Sc., in Microbiology
Credit based Choice Based Continuous Evaluation Pattern System
(B.Sc. Honors and M. Sc. Microbiology)
80 credits course

DEPARTMENT OF STUDIES IN MICROBIOLOGY
MANASAGANGOTRI
MYSORE – 570 006

2013 -14

University of Mysore
Department of Studies in Microbiology
Credit Based Choice Based Continuous Evaluation Pattern System

SCHEME OF THE STUDY

For B.Sc. (Honors) in Microbiology

Credits to be earned	: 40 credits
Core papers	: 16 credits
Open elective paper	: 04 credits
Transborder /cross disciplinary/ Discipline centric elective papers	: 16 credits
Project work / term work	: 04 credits

For M. Sc. in Microbiology

Credits to be earned	: 40 credits
Cumulative total of credits to be completed	: 40 (Honors)+ 36 (Masters) = 80 credits
Core papers	: 20 credits
Trans-border/cross disciplinary/ Discipline centric elective papers	: 12 credits
Project work / term work	:08 credits

Honors in Microbiology

Credit based Choice Based continuous evaluation pattern System
Proposed Semester-wise distribution of the course structure for the year 2012-2013

Semester-I Credits: 20

No	Paper Code	Title of the course paper	Credit pattern in L:T:P	Credits
1	MB 1.1 Hardcore	Virology	3:1:0	4
2	MB 1.2 Hardcore	Bacteriology	3:1:0	4
3	MB 1.3 Hardcore	Mycology	3:1:0	4
Select 3 among 4 soft core				
4a	MB 1.4a Softcore	Microbial Genetics	3:1:0	4
	MB 1.4b Softcore	Microbial Ecology & Diversity	3:1:0	4
5	MB 1.5 Softcore	Practical I	0:0:2	2
6	MB 1.6 Softcore	Practical II	0:0:2	2

HC= 03; SC=03; O.E=0.

Semester-II Credits: 20

No	Paper Code	Title of the course paper	Credit pattern in L:T:P	Credits
1	MB 2.1 Hardcore	Microbial Physiology	3:1:0	4
2	MB 2.2 Hardcore	Environmental Microbiology	3:1:0	4
Select 3 among 4 soft core				
3	MB 2.3a Softcore	Food & Dairy Microbiology	3:1:0	4
	MB 2.3b Softcore	Soil Microbiology	3:1:0	4
4	MB 2.4 Softcore	Practical III	0:0:2	2
5	MB 2.5 Softcore	Practical IV	0:0:2	2
6	MB 2.6 O.E	Microbial World	2:2:0	4

HC= 02; SC=03; O.E=01.

M. Sc. Microbiology
Credit Based Choice Based Continuous Evaluation Pattern System
Proposed Semester-wise distribution of the course structure

Semester-III Credits: 20

No	Paper Code	Title of the course paper	Credit pattern in L:T:P	Credits
1	MB 3.1 Hardcore	Immunology	3:1:0	4
2	MB 3.2 Hardcore	Molecular Biology	3:1:0	4
3	MB 3.3 Hardcore	Clinical & Diagnostic	3:1:0	4
Select 3 among 4 soft core				
4	MB 3.4a Softcore	Genetic Engineering	3:1:0	4
	MB 3.4b Softcore	Genomics & Proteomics	3:1:0	4
5	MB 3.5 Softcore	Practical V	0:0:2	2
6	MB 3.6 Softcore	Practical VI	0:0:2	2
7	MB 3.7 O.E	Microbial Technology	2:2:0	4

HC= 03; SC=03; O.E=01.

Semester-IV Credits: 20

No	Paper Code	Title of the course paper	Credit pattern in L:T:P	Credits
1	MB 4.1 Hardcore	Medical Microbiology	3:1:0	4
Select 2 among 3 soft core				
2	MB 4.2a Softcore	Industrial Microbiology	3:1:0	4
	MB 4.2b Softcore	Agricultural Microbiology	3:1:0	4
3	MB 4.3 Softcore	Practical VII	0:2:2	4
4	MB 4.4 Hardcore	Project Work	0:2:6	8

HC=01; SC=02; O.E=0; Project work=01.

Grand Total Credits: 80

SEMESTER I

MB 1.1 Hardcore: VIROLOGY

THEORY

1. **The science of virology:** Concept and scope of virology. Foundations of virology: Virus prehistory, discovery of viruses. Definitive properties of viruses: Morphology, Ultra structure, Chemical composition - proteins, nucleic acids, and other contents. Classification and nomenclature of viruses. Trends in virology. Evolutionary importance of viruses.
 2. **Working with viruses:** Visualization and enumeration of virus particles, Biological activity of viruses, Physical and chemical manipulation of the structural components of viruses, Characterization of viral product expressed in the infected cells. Isolation and purification of viruses, Detection of viruses: physical, biological, immunological and molecular methods.
 3. **Sub-viral particles:** Discovery, Structure, Classification, replication and diseases caused by Satellite, Satellites virus, Virusoids, Viroids and Prions.
 4. **Prevention and control of viral diseases:** Introduction to viral vaccines, preparation of vaccines, new vaccine technology; antiviral drugs, antiviral gene therapy.
 5. **Viruses and the future:** Promises and problems. Emerging diseases, sources and causes of emergent virus diseases. Prospectus using medical technology to eliminate specific viral and other infectious diseases. **Silver lining:** viruses as therapeutic agents, viruses for gene delivery, viruses to destroy other viruses. Importance of studying modern virology.
- 3-4. Isolation of coliphages from sewage and testing for plaque formation by infecting susceptible bacterial culture.
- 5-6 Extraction and artificial inoculation of TMV to healthy tobacco plant and study of Viral symptoms.

REFERENCES:

Black, J.G. 2002. Microbiology-Principles and Explorations. John Wiley and Sons, Inc. New York.

- Brock, T.D. and Madigan, M.T. 1988. Biology of Microorganisms, V Edition. Prentice Hall. New Jersey.
- Dimmock, N. J., Easton, A. J., and Leppard, K. N. 2001. Introduction to Modern Virology. 5th edn. Blackwell publishing, USA.
- Flint, S.J., Enquist, L.W., Drug, R.M., Racaniello, V.R. and Skalka, A.M. 2000. Principles of Virology- Molecular Biology, Pathogenesis and Control. ASM Press, Washington, D.C.
- Presscott, L. M., Harley, J. P. and Klein, D. A. 1999. Microbiology, International edn. 4th edn. WCB Mc Graw-Hill
- Wagner, E.K. and Hewlett, M.J. 1999. Basic Virology. Blackwell Science. Inc.

MB 1.2 Hardcore: BACTERIOLOGY

THEORY **32 Hours**

UNIT I **8 hours**

Historical overview of bacteriology: Spontaneous generation conflict, Antony van Leeuwenhoek, Louis Pasteur, Robert Koch, Paul Ehrlich, Alexander Fleming. Important events in development of bacteriology, Scope and relevance of bacteriology.

Ultrastructure and Reproduction in Bacteria: An overview of bacterial size, shape and arrangement, Bacterial cell wall, Plasma membrane, Internal membrane systems, Cytoplasmic matrix, nucleoid, Inclusion bodies, Ribosomes, Flagella and pili, Bacterial motility and Endospore. Fission, budding, conjugation, transformation, transduction and recombination.

UNIT II **8 hours**

Cultivation of Bacteria: Aerobic, anaerobic, batch and continuous cultivation. Nutritional requirements: Micro and macro nutrients, Chemical elements as nutrients. Culture media: Classification of media, broth, solid and semisolid media. Simple, complex and special media. Preparation of bacterial stains: staining (positive and negative), Differential staining (Gram's staining and acid-fast staining), Structural staining (Capsule, flagella, cell, and endospore of bacteria) and nuclear staining.

UNIT III **8 hours**

Characteristics and Salient features of major groups of Bacteria: Taxonomy of bacteria – Bergy's Manual of Systematic Bacteriology – characteristics of major groups of bacteria Archaeobacteria – general characteristics and classification; Actinomycetes – general characteristics and classification, diversity and distribution, economic importance.

Cyanobacteria – general characteristics and classification – ultra-structure, reproduction and economic importance. Mycoplasma – general characteristics and examples, growth and multiplication, their significance.

UNIT IV

8 hours

Economic importance of bacteria: A brief account of economic importance of bacteria in Agriculture (Biofertilizers-*Rhizobium*) growth promoting bacteria, *Azospirillum*. Biopesticides-*Bacillus thurengiensis*), industry- brewing, medicine-Vaccines, hormones and environment- bioleaching, bioremediation. Role of archaebacteria in the evolution of microbial world and their economic importance.

PRACTICALS

4X8=32

Hours

1. Preparation of nutrient media and sterilization techniques, colony characters of bacteria.
2. Bacterial pure culture and subculture techniques.
3. Isolation of bacteria from air.
4. Isolation of bacteria from water.
5. Isolation of bacteria from soil.
6. Staining techniques – simple, gram, acid-fast.
7. Motility test
8. Endospore staining.
9. IMViC
10. Urease test
11. TSI
10. Capsule staining
1. Morphological characteristics of bacteria.

References:

- Alcomo, I.E. 2001. Fundamentals of Microbiology. VI Edition, Jones and Bartlett Publishers, Sudbury, Massachusetts.
- Aneja, K.R. 1993. Experiments in Microbiology, Plant Pathology. Rastogi and company, Meerut.
- Cappuccino, J. G. and Sherman, N. 1999. MICROBIOLOGY A Laboratory Manual 4th Edn. Addison – Wesley.
- Barsanti, L and Gualtieri, P. 2005. Algae: Anatomy, Biochemistry, and Biotechnology. Taylor and Francis New York.

- Becker, W. M., Kleinsmith, L.J. and Hardin, J. 2000. The world of the Cell. IVth Edition. Benjamin/Cummings.
- Hogg, S. 2005. Essential Microbiology. John Wiley and Sons, Ltd.,
- Holt T S, Kriek N R, Sneath PHA & Williams S T. 1994. Bergey's Manual of Determinative Bacteriology 9th Edn. Williams & Wilkim, Baltimore
- Madigan M.T., Martinko M. J. and Jack Parker. 2003. Brock Biology of microorganisms. Pearson education., New Jercey.
- Pelczar, (Jr.) M. J., Chan, E. C. S. and Kreig, N. R.1993. Microbiology. McGraw Hill, New York
- Perry, J.J., Staley, J.T. and Lory, S. 2002. Microbial Life. Sinauer Associates, Publishers, Sunderland, Massachusetts.
- Presscott, L. M. Harley, J. P. and Klein, D. A. 1999. Microbiology, International edn. 4th edn. WCB Mc Graw-Hill.
- Satyanarayana, T and Johri, B. N. 2005. Microbial Diversity – Current Perspectives and Potential Applications. I K Int. Pvt. Ltd. New Delhi.
- Schaechter, M. Ingraham, J.L. and Neidhardt, F.C. 2006. Microbe. ASM Press, Washington. D.C.
- Stainer, R. Y., Ingraha, J L, Wheelis, M. L. and Painter, P. K. 1986. General Microbiology. Mc Millan Edun. Ltd. London.
- Stanley J.T. and Reysenbach A.L.1977. Biodiversity of microbial life. John Wiley 7 Sons Inc. Publication. New York.
- Sullia, S.B. and Shantharam,S. 2000. General Microbiology (Revised) Oxford & IBH Publishing Co. Pvt. Ltd.
- Talaro, K and Talaro A.1996. Foundations in Microbiology, II edition, WCB publishers.
- Tortora, G.J., Funke, B.R. and Case C.L. 2004. Microbiology-An Introduction. Benjamin Cummings. San Francisco.

MB 1.3 Hardcore: MYCOLOGY

THEORY

32 Hours

UNIT I

8 hours

A) Introduction: History and Development of Mycology, scope of mycology. Recent developments in Mycology.

B) Fungal taxonomy: Taxonomic problems associated with variation in fungi, Classification of fungi (Alexopoulos and Mims).

UNITII

8 hours

A) General characteristics of fungi and reproduction: Morphology and somatic structures: The thanllus, organization, fungal cell, nuclear components, specialized somatic structures; Aggregation of hyphae, tissues, mycangia, General aspects of fungal nutrition and reproduction (Asexual, Sexual reproduction, Heterothalism and Parasexuality)

UNIT III

8 hours

Salient features of fungal major groups: Chitridiomycota, Zygomycota, Basidiomycota,

Ascomycota, Deuteromycota, Oomycota, Hypochytriomycota, Labyrinthulomycota, Plasmodiophoromycota and Myxomycota. Symbiotic fungi- Lichens.

UNIT I V

8 hours

Economic importance of fungi: Fungi as biocontrol agent, importance of Fungi in Agriculture, Industry and medicine. Fungi as SCP, Fungi as parasites of human and plants.

MYCOLOGY PRACTICALS

1. Isolation of slime molds.
2. Isolation of aquatic fungi.
3. Isolation of soil fungi.
4. Isolation of fungi from air.
5. Isolation of fungi from cereals and cereal based products.
6. Study of the following representative genera: *Aspergillus*, *Penicillium*, *Fusarium*, *Neurospora*, *Saccharomyces*, *Erysiphae*, *Polyporus*, *Agaricus*, *Puccinia*, *Ustilago*, *Alternaria*, *Drechslera*, *Saprolegnia*, *Rhizopus*, *Trichoderma* and symbiotic fungi- Lichens.
7. Measurement of concentration of fungal conidia by Haemocytometer.
8. Measurement of fungal cells by Micrometer.
9. Study of *Chlorella*, *Scenedesmus*, *Cyclotella*, *Pinnularia*
10. Study of *Entamoeba*, *Trypanosoma*, *Leishmania*, *Plasmodium*

Reference:

- Alexopoulos C J and Mims C W, 1979 Introductory Mycology 3rd edn, Wiley Eastern.,New Delhi.
- Bold, H.C. & Wyne M.j. 1978. Introduction to the algae: Structure and Reproduction:Prentice Hall and Englewood Cliffs, N.J.
- Chapman & Chapman 1973. The Algae; Macmillan Co. N.Y.
- Deacon, J W,1997- Modern Mycology 3rd Edition, Blackwell Science publishers, London.
- Landecker E M, 1972 Fundamentals of Fungi Prentice-Hall, Angelwood Cliff, New Jersey.
- Landecker E M, 1982 Fundamentals of the Fungi. 2nd Edn. Prentice Hall Inc.
- Mehrotra, RS & Aneja, K R, 1998. An Introduction to Mycology. New Age International Pvt. Ltd. New Delhi.
- Odum, E.P. 1971. Fundamentals of Ecology; Third Edition. Toppan Co. Ltd. Tokyo, Japan.

MB 1.4a Softcore: MICROBIAL GENETICS

THEORY

32 Hours

UNIT I

8

hours

Concepts in Microbial Genetics: **History and developments of Microbial genetics. Essentials of microbial genetics: Microbes as Genetic Tools for Basic and Applied Genetic studies. Advantages and disadvantages of Microbes, Generalized reproductive**

cycles of microbes - Viruses, Bacteria, *Neurospora*, *Saccharomyces*, *Chlamydomonas* and *Acetabularia*.

UNIT II

8

hours

A) Viral and Bacterial Genetics: Lytic and Lysogenic cycles, Phage Phenotypes, Phenotypic Mixing, Recombination in viruses: Mutations, Recombination and Mapping.

B) Bacterial Genetics: Bacterial Transformation: Types of transformation mechanisms found in prokaryotes, Bacterial Conjugation: properties of the F plasmid, $F^+ \times F^-$ mating, $F' \times F^-$ conjugation, Hfr conjugation. Transduction: Generalized and specialized transduction, Transposable elements.

UNIT III

8

hours

A) Fungal and Algal Genetics: *Neurospora*- Tetrad analysis and linkage detection - 2 point and 3 point crosses, chromatid and chiasma interference, Mitotic recombination in *Neurospora* and *Aspergillus*.

B) Algal Genetics: *Chlamydomonas* - unordered tetrad analysis - Recombination and Mapping, Nucleocytoplasmic interactions and gene expression in *Acetabularia*. Extra nuclear (Cytoplasmic) inheritance.

UNIT IV

8

hours

Mutation and mutagenesis: Nature, type and effects of mutations. Mutagenesis – physical and chemical mutagens, base and nucleoside analog, alkylating agents, interrelating agents, ionizing radiation. Induction and detection of mutation in microorganisms. Site directed mutagenesis and its applications.

References:

Brooker, R. J. 1999. *Genetics – Analysis and Principles*. Benjamin/Cummings, an imprint of addition Wesley longman, Inc.

Gardner, E. J. 1984. *Principles of Genetics* 7th edn. John Wiley & Sons. Inc. New York.

Hartl, D.L. 1994. *Genetics*. Jones and Bartler Publishers, London.

Moat, A.G., Foster, J.W. and Spector, M.P. 2002. *Microbial Physiology*, 4th edn. Wiley-Liss, Inc., New York.

Stanley R. Maloy, *Microbial Genetics Second Edition*, University of Illinois, Urbana, John Cronan, Jr., University of Illinois, Urbana, David Freifelder, Late of the University of California, San Diego

Strickberger, M. W.1985. *Genetics*, 3rd Edn. Mac. Millan Pub. Co. Inc. NY.

PRACTICALS

4X8=32

Hours

1. Replica plating technique for transfer of bacterial colonies.
2. Demonstration of Bacterial transformation.
3. Demonstration of Plate mating.
4. Genetic recombination (Conjugation) in Bacteria.
5. Isolation of streptomycin resistant strain of *E. coli* by gradient plate method.
6. Selection of Diploids in *Aspergillus nidulans*
7. Genetic segregation of *Sordaria fimicola*
8. Ordered and random ascospore analysis in *Neurospora crassa*
9. Ultra-violet killing curve and determination of mutant types in *Saccharomyces cerevisiae*.
10. Induction of mutation

MB 1.4b Softcore: MICROBIAL ECOLOGY AND DIVERSITY

Unit 1

A) Introduction to microbial ecology. structure of microbial communities.

Interaction among microbial populations. Interaction between microorganisms and plants. Biotransformation, biodegradation, bioremediation and phytoremediation. Ecological and Evolutionary diversity (Genetic diversity) of microbial world.

B) Classification and Naming of Microorganisms: Classification systems, ICNB Rules, Major Characteristics used to Classify Microorganisms, taxonomic diversity.

UNIT II

8 hours

A) Viral Diversity: Group I – T2 Bacteriophage, Group II – Banana bunchy top virus, Group III – Reovirus, Group IV- TMV, Group V – Rhabdovirus, Group VI – HIV, Group VII – Hepatitis virus.

Sub-viral particles: Discovery, Structure, Classification, replication and diseases caused by Satellite, Satellites virus, Virusoids, Viroids and Prions.

B) Bacterial Diversity: Archaeobacteria, Photosynthetic Eubacteria, Chemoautotrophic and Methophilic Eubacteria, Gliding Eubacteria, Spirochetes, Rickettsiae and Chlamydiae, Actinomycetes, Mollicutes, Protists.

UNIT III

8 hours

Fungal Diversity: salient features of the following group: Zygomycota (*Rhizopus*), Ascomycota (*Neurospora*), Basidiomycota (*Agaricus*), Deuteromycota (*Penicillium*), Chytridiomycota (*Allomyces*), Myxomycota and Yeast.

UNIT IV

8 hours

Importance and Conservation of Microbial Diversity: Importance of microbial diversity in environment, pharmaceuticals & human health. Metagenomics Importance of conservation.

In situ conservation and *Ex situ* conservation. Role of culture collection centers in conservation.

PRACTICALS

4X8=32 Hours

1. Isolation and identification of Bacteria (up to the generic level) from food and water.
2. Isolation and identification of air microflora by Andersen sampler.
3. Isolation and identification and study of Actinomycetes from soil.
4. Isolation and identification and study of Cyanobacteria from soil / paddy field.
5. Isolation and study of Bacteriophages from sewage.
6. Preparation of basic solid media agar slants and agar deep tubes for cultivation of fungi.
7. Isolation and identification of fungi from soil/cereals/water by serial dilution technique.
8. Study of symbiotic fungi.
9. Isolation and Staining of Vesicular Arbuscular Mycorrhizae from soil.
10. Isolation of Aquatic fungi.
11. Isolation and identification and study of Algae from water.
12. Measurement of concentration of microorganism by Haemocytometer.
13. Measurement of microorganism by Micrometer.
14. Identification of Yeast

References

- Alexopoulos, C. J. and Mims, C. W. 1979. Introductory Mycology. III edition, Wiley Eastern, New Delhi.
- Dimmock, N. J., Easton, A. J. and Leppard, K. N. 2001. Introduction to Modern Virology. 5th edn. Blackwell publishing, USA.
- Ghosh, A. 2003. Natural Resource Conservation and Environment Management. Aph Publishing Corp. Calcutta.
- Landecker, E. M. 1972. Fundamentals of Fungi. Prentice-Hall, Angelwood Cliff, New Jersey.
- Madigan M.T., Martinko M. J. and Parker, J. 2003. Brock Biology of microorganisms. Pearson education., New Jersey.
- Pelczar, (Jr.) M. J., Chan, E. C. S. and Kreig, N. R. 1993. Microbiology. McGraw Hill, New York
- Perry, J.J. and Staley, J.T. 1997. Microbiology. Dynamics and Diversity. 4th edn. Wesley Longman pub. New York.
- Presscott, L. M., Harley, J. P. and Klein, D. A. 1999. Microbiology. 4th edn. WCB Mc Graw-Hill, New Delhi.
- Satyanarayana, T. and Johri, B. N. 2005. Microbial Diversity – Current Perspectives and Potential Applications. I K Int. Pvt. Ltd. New Delhi.
- Stainer, R. Y., Ingraha, J. L., Wheelis, M. L. and Painter, P. K. 1986. General Microbiology. Mc Millan Edun. Ltd. London.
- Stanley J.T. and Reysenbach A.L. 1977. Biodiversity of microbial life. John Wiley & Sons Inc. Publication. New York.
- Wagner, E.K. and Hewlett, M.J. 1999. Basic Virology. Blackwell Science. Inc. CORE PAPER

SEMESTER II

MB 2.1 Hardcore: MICROBIAL PHYSIOLOGY

THEORY	32
Hours	
UNIT I	8
hours	
Microbial Physiology: Microbial Energetics, The role of ATP in metabolism. Microbial enzymes: Structure and Classification, Mechanism of Enzyme actions: Lock and Key model, induced fit Theory, Factors affecting rates of enzyme mediated reactions (pH, temperature and substrate and enzyme concentration), Enzyme Inhibition and Enzyme regulation.	
UNIT II	8
hours	
Metabolism of Carbohydrate: Glycolysis, Citric acid Cycle and Oxidative level Phosphorylation, Fates of pyruvate, Fermentation. Utilization of sugars other than glucose: Lactose, Galactose, Maltose, Mannitol. Degradation of cellulose, Starch and Glycogen.	
UNIT III	8
hours	
Metabolism of other Substrates: Lipid metabolism: β -oxidation, Biosynthesis of fatty acids, degradation of fatty acids. Nitrogen metabolism: Nitrogen metabolism, Biological nitrogen fixation process, symbiotic and non symbiotic nitrogen fixation. urea cycle, degradation and biosynthesis of essential and non-essential amino acids. Nucleic acid metabolism: Biosynthesis and degradation of purines and pyrimidines.	
UNIT IV	8
hours	
A) Microbial Photosynthesis: Photosynthetic Pigments and apparatus in bacteria. Oxygenic and An-oxygenic Photosynthesis. Autotropic CO ₂ fixation and mechanism of Photosynthesis. Utilization of light energy by Halobacteria.	
B) Autotrophic Mechanisms in bacteria: Hydrogen bacteria, Nitrifying bacteria, Purple sulfur bacteria, Non-sulfur bacteria, Green sulfur bacteria, Iron bacteria, Methylootrophs.	
C) Microbial Stress Responses: Oxidative stress, Thermal stress, Starvation stress, Aerobic to anaerobic transitions.	

References:

- Alcomo, I.E. 2001. Fundamentals of Microbiology. VI Edition, Jones and Bartlett Publishers, Sudbury, Massachusetts.
- Barsanti, L, and Gualtieri, P. 2005. Algae: Anatomy, Biochemistry and Biotechnology. Taylor and Francis New York.
- Becker, W. M., Kleinsmith, L.J. and Hardin, J. 2000. The world of the Cell. IVth Edition. Benjamin/Cummings.
- Dubey, R.C. and Maheshwari, D.K. 1999. A Text Book of Microbiology. S. Chand and Company Limited, Ram nagar, New Delhi.
- Horton, H.R., Moran, L. A., Scrimgeour, K.G. Perry, M.D. and Rawn, J.D. 2006. Principles of Biochemistry, IVth Edition. Pearson Education International. London.
- Madigan M.T., Martinko M. J. and Jack Parker. 2003. Brock Biology of microorganisms. Pearson education., New Jersey.
- Moat, A.G., Foster, J.W. and Spector, M.P. 2002. Microbial Physiology, 4th edn. Wiley-Liss, Inc., New York.
- Nelson, D.L. and Cox, M.M. 2000. Lehninger Principles of Biochemistry 3rd edn. Printed in India by Replika Press Pvt. Ltd., New Delhi for Worth Publishers, New York.
- Palmer, T. 2004. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry. Affiliated East-West Press Pvt. Ltd. New Delhi.
- Pelczar (Jr.) M. J. Chan, E. C. S. and Kreig, N. R. 1993. Microbiology, McGraw Hill Int. Newyork.
- Perry, J.J. and Staley, J.T. 1997. Microbiology. Dynamics and Diversity. 4th edn. Wesley Longman pub. New York.
- Perry, J.J., Staley, J.T. and Lory, S. 2002. Microbial Life. Sinauer Associates, Publishers, Sunderland, Massachusetts.
- Presscott, L. M. Harley, J. P. and Klein, D. A. 1999. Microbiology, International edn. 4th edn. WCB Mc Graw-Hill.
- Schaechter, M. Ingraham, J.L. and Neidhardt, F.C. 2006. Microbe. ASM Press, Washington. D.C.
- Stainer R. Y, Ingraha, J.L., Wheelis, M. L. and Painter, P. K . –1986, General Microbiology Mc Millan Edun. Ltd. London
- Stanley J.T. and Reysenbach A.L.1977. Biodiversity of microbial life. John Wiley 7 Sons Inc. Publication. New York.
- Stenesh, J. 1998. Biochemistry Vol. II, Plenum Press, New York and London.
- Sullia, S.B. and Shantharam,, S. 2000. General Microbiology (Revised) Oxford & IBH Publishing Co. Pvt. Ltd.
- Talaro, K. and Talaro, A.1996. Foundations in Microbiology, 2nd edition,WCB publishers.
- Tortora, G.J., Funke, B.R. and Case, C.L. 2004. Microbiology-An Introduction. Benjamin Cummings. San Francisco.
- Voet, D., Voet, J.G. and Pratt, C.W. 1999. Fundamentals of Biochemistry, John Wiley and Sons Inc., New York and Toranto.

PRACTICALS
Hours

4X8=32

1. Effect of Environmental factors on microbial growth.
2. Study of acid and pH stress tolerance by microbes.
3. Population growth of yeast – *S. cerevisiae*.
4. Sugar fermentation tests.
5. Urease test.
6. Triple Sugar Iron Test.
7. IMViC tests.
8. Catalase activity.
9. Hydrolytic rancidity.
10. Casein hydrolysis.

MB 2.2 Hardcore: ENVIRONMENTAL MICROBIOLOGY

THEORY

32 Hours

UNIT I

8 hours

Environmental Microbiology: Concepts and scope of environmental microbiology.
Microbiology of Air: Airspora of indoor and outdoor environment, factors affecting airspora, Techniques of trapping air borne microorganisms.

UNIT II

8 hours

Aquatic Microbiology: Distribution of microorganisms in the aquatic environment, Water pollution sources, Biological indicators of water pollution, Determination of sanitary quality of water, Waste water treatment.

UNIT III

8 hours

A) Microbes in extreme environment: Microbes of extreme environments, Thermophiles, acidophiles, alkaliphiles, halophiles. barophiles and their survival mechanisms.
B) Space microbiology: Historical development of space microbiology, Life detection methods **a)** Evidence of metabolism (Gulliver) **b)** Evidence of photosynthesis (autotrophic and heterotrophic).

UNIT IV

8 hours

Microbes in the degradation of wastes: Treatment of solid and liquid industrial wastes, Microbial degradation of pesticides, Xenobiotics, bioremediation - advantages and disadvantages. **Geomicrobiology:** Microbes in metal extraction, mineral leaching and mining, copper extraction by leaching and microbes in petroleum product formation.

PRACTICALS

4X8=32 Hours

2. Isolation and identification sewage micro flora.
3. Isolation and identification soil micro flora.
4. Isolation and Identification of airborne microbes– indoor and outdoor.
5. Microbes as indicators of water pollution – Determination of indices of water quality.
6. Determination of BOD of pollution water.
7. Determination of COD of polluted water.
8. Effect of high salt concentration on microbial growth.
9. Degradation of cellulose by *Chaetomium globosum*.
10. Bacterial examination of drinking water by membrane filter technique.
11. Study of associated soil microorganisms with plants, Actinorhiza, Mycorrhiza.
12. Study of important microbes in the degradation of wastes.

References:

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MB 2.3a Softcore: FOOD AND DAIRY MICROBIOLOGY

THEORY

32 Hours

UNIT I

8 hours

Introduction to food microbiology: Definition, concepts and scope. Food as substrate for microbes. Factors influencing microbial growth in food-Extrinsic and intrinsic factors.

Principles of food preservation- Chemical preservatives and Food additives Asepsis- Removal of microorganisms, (anaerobic conditions, high temperatures, low temperatures, drying). Canning, processing for Heat treatment.

UNIT II

8 hours

A) Contamination and food spoilage: Cereals, sugar products, vegetables, fruits, meat and meat products, Fish and sea foods- poultry- spoilage of canned foods.

B) Dairy Microbiology: Microbiology of raw milk, Milk as a vehicle of pathogens, Prevention of contamination of raw milk, Microbiology of processed milk, Spoilage and defects fermented milk and milk products, Microbiological standards for milk and milk products. Cream and butter bacteriology.

UNIT III

8 hours

A) Food poisoning and intoxication: Significance of food borne diseases, Staphylococcal, Gastroenteritis and enterotoxins: Types and incidence, Prevention of Staphylococcal and other food poisoning syndromes, *Clostridium perfringens* food poisoning and Botulism, *Bacillus cereus* food poisoning, Food borne Listeriosis by *Listeria monocytogenes*, Food borne Gastroenteritis by *Salmonella* and *Shigella*, *Vibrio*, *Campylobacter* and *Yersinia*, fungal spoilage and Mycotoxins.

B) Food produced by Microbes: Microbial cells as food (single cell proteins)- mushroom cultivation. Bioconversions- production of alcohol-fermented beverages- beer and wine. Genetically modified foods.

UNIT IV

8 hours

A) Detection of food-borne microorganisms: Culture, Microscopic and Sampling methods.. Chemical: Thermostable nuclease *Limulus* Lysate for Endotoxins, Nucleic Acid (DNA) probes, DNA Amplification (PCR), Adenosine- Triphosphate Measurement, Radiometry, Fluoro-and Chromogenic substrates. **Immunologic Methods:** Fluorescent Antibody, Enrichment Serology, Salmonella 1-2. Test, Radioimmunoassay, ELISA.

B) Microbial indicators of food safety and quality control: Principles of quality control and microbiological criteria, Indicators of product quality and microbiological safety of foods, Hazard analysis, critical control points (HACCP), Good manufacturing process (GMP) Microbiological standards Codex Alimentarius and Food legislation.

PRACTICALS : FOOD AND DAIRY MICROBIOLOGY

4X8=32 Hours

1. Enumeration of food borne bacteria.
2. Enumeration of food borne fungi
3. Determination of TDT.
4. Determination of TDP.
5. Detection and quantification of Aflatoxin B1.

6. Detection of food-borne bacteria by immunoassays.
7. Detection and enumeration of Microorganisms present in Utensils.
8. Enumeration and quantification type of microorganisms present in fruit and vegetable.
9. Isolation and identification of pathogenic microorganisms from canned food.
- 10 – 11. Food Preservation Methods.
12. Enumeration of bacteria in raw and pasteurized milk by SPC method.
13. Determination of quality of a milk sample by MBRT.
14. Detection of number of bacteria in milk by breed-count method.
15. Litmus milk test.
16. Microbial quality of milk products.
17. Microbiological examination of Ice-cream and Dairy products.

References:

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MB 2.3b Softcore: SOFT CORE 3.2: SOIL MICROBIOLOGY

THEORY

32 Hours

Unit I

4 Hours

Soil Microbiology : Historical accounts and the “Golden Age” of soil microbiology and significant contributions of pioneer soil microbiologists.

Unit II

4 Hours

Soil Microbial diversity: Diversity and abundance of dominant soil microorganisms, Methods of isolation of soil microflora, soil organic matter decomposition,

Unit III

4 Hours

Biogeochemical cycles: carbon, nitrogen, sulphur and iron cycles in soil.

UNIT-IV

4 Hours

Soil microbe interaction - Antagonism, commensalism, mutualism, symbiosis, predators and parasite relationship and competition. Interaction of soil microflora with vascular plants - Rhizosphere, rhizoplane microorganisms, Rhizobium, Azotobacter, Azospirillum, Cyanobacteria and Azolla.

Unit- V

4 Hours

Applied soil microbiology: soil microbial inoculants, Manipulations of soil microorganisms for agriculture, Soil environmental contaminants and Bioremediation, Microbial products- Plant growth promoting Hormones, Antibiotics, Toxins and Enzymes

Unit- VI

4 Hours

Soil-Borne Diseases and Human Health: *Clostridium tetani* (tetanus), Toxoplasmosis, Aspergillosis, Actinomyces.

Practicals:

1. Microbial flora of soil.
2. Microbial degradation of cellulose by *Chaetomium globosum*
3. Soil microbes interaction *In vitro* by dual culture method
4. Isolation, identification and enumeration of Rhizosphere and Rhizoplane microorganism
5. Isolation of Rhizobium from roots of leguminous plant
6. Preparation of soil microbial inoculants- Azotobacter, Azospirillum
7. Isolation and Identification of soil pathogenic organisms causing human diseases.

References:

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Motsara, I.M.R., Bhattacharyya, P. and Srivastava, B. 1995. Biofertilizer Technology, Marketing and usage-A source Book-cum- glossary- FDCO, New Delhi.

Somasegaran, P and H.J. Hoben, 1994. Hand book for Rhizobia; methods in legume *Rhizobium* Technology. Springer-Verlan, New York.

MB 2.6 Open elective: MICROBIAL WORLD

THEORY **32 Hours**

UNIT I **8 hours**

Viral Diversity: Morphology, ultra structure, chemical composition of virus, classification of viruses, Group I – T2 Bacteriophage, Group II – Banana bunchy top virus, Group III – Reovirus, Group IV- TMV, Group V – Rhabdovirus, Group VI – HIV, Group VII – Hepatitis virus. **Sub-viral particles:** Discovery, Structure, Classification, replication and diseases caused by Satellite, Satellites virus, Virusoids, Viroids and Prions.

UNIT II **8 hours**

Bacterial Diversity: Archaeobacteria, Photosynthetic Eubacteria, Chemoautotrophic and Methophilic Eubacteria, Gliding Eubacteria, Spirochetes, Rickettsiae and Chlamydiae, Actinomycetes, Mollicutes, Protists. Classification based on Bergey's manual (Determinative & Systematic).

UNIT III **8 hours**

Fungal Diversity: Classification, Distribution, Importance, Structure, reproduction and general characteristics of the fungal divisions: Zygomycota (*Rhizopus*), Ascomycota (*Neurospora*), Basidiomycota (*Agaricus*), Deuteromycota (*Penicillium*), Chytridiomycota (*Allomyces*), Myxomycota and Yeast.

UNIT IV **8 hours**

Importance and Conservation of Microbial Diversity: Importance of microbial diversity in agriculture, forestry, environment, industrial & food biotechnology, animal & human health. Metagenomics . Importance of conservation. *In situ* conservation and *Ex situ* conservation. Role of culture collection centers in conservation.

PRACTICALS

4X8=32 Hours

12. Isolation and identification of Bacteria (up to the generic level) from food and water.
13. Isolation and identification of air microflora by Andersen sampler.
14. Isolation and identification and study of Actinomycetes from soil.
15. Isolation and identification and study of Cyanobacteria from soil / paddy field.
16. Isolation and study of Bacteriophages from sewage.
17. Preparation of basic solid media agar slants and agar deep tubes for cultivation of fungi.
18. Isolation and identification of fungi from soil/cereals/water by serial dilution technique.
19. Study of symbiotic fungi.
20. Isolation and Staining of Vesicular Arbuscular Mycorrhizae from soil.
21. Isolation of Aquatic fungi.
22. Isolation and identification and study of Algae from water.
12. Measurement of concentration of microorganism by Haemocytometer.
13. .Measurement of microorganism by Micrometer.
14. Identification of Yeast

References

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SEMESTER III

MB 3.1 Hardcore: IMMUNOLOGY

THEORY

32 Hours

UNIT I

8 hours

Introduction to Immunology: An overview of immune system, Phagocytes, Natural killer cells, mast cells, basophils, Dendritic cells and other cells of the innate immune system.

Immunity: Types: Innate immunity: (nonspecific) physical, biochemical and genetic factors involved in governing innate immunity, molecules of innate immunity – complement, acute phase proteins and interferons; Acquired immunity: (specific) natural, artificial, passive immunity, Humoral or antibody mediated immunity, cell mediated immunity.

UNIT II

8 hours

Antigens and Antibodies: Antigen processing and presentation, properties of antigen, Super antigen, Hapten; Haptens and the study of antigenicity Microbes as antigen Antigen recognition and MHC molecules. Antibodies – structure and function, clonal selection, antibody diversity, monoclonal antibodies and its clinical applications, Antibody engineering (Construction of monoclonal antibodies Lymphoma and other diseases by genetically engineered antibodies.

UNIT III

8 hours

Immunological disorders: Hypersensitivity Type I to Type IV, Immunodeficiency diseases; AIDS and other acquired or secondary immunodeficiencies, HIV – 1 infection and opportunistic infections. Autoimmuno diseases

UNIT IV

8 hours

Immunotechniques and Immunodiagnosis: Antigens and Antibody reactions *in vitro*; Agglutination, complement fixation, ELISA, Western Blotting, Immunodiffusion, Immunoelectrophoresis, Immunofluorescence, Immunoprecipitation, Radioimmunoassay and serotyping.

PRACTICALS

4X8=32 Hours

1. Immunological Methods used for organism detection – production of antibodies for use in laboratory testing.
2. Serological Diagnosis of Infectious diseases – Serologic test Methods.
- 3-7 Precipitin test, ELISA, Ouchterlony Immunodiffusion test, Immunoelectrophoresis, Complement fixation test.
- 8-10. Isolation of Antigens and raising antibodies from animals (from different Models), Development of polyclonal antibodies, purification of antibodies.
11. WIDAL Test.
12. VDRL Test (RPR).
13. HBs Ag Test.
14. HCG test (Agglutination inhibition test).
15. Detection of RA factor.
16. CRP test.

17.ASO Test (Anti streptolysin 'O' Test).

References:

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MB 3.2 Hardcore: MOLECULAR BIOLOGY

THEORY

32 Hours

UNIT I

8 hours

A) Concepts in Molecular Biology: Microbes in molecular biology. **Organization of Genomes:** Prokaryotic genome- Genetic and Physical organization of bacterial genome, Eukaryotic genome – Genetic and Physical organization of nuclear genome

B) DNA structure and Replication: DNA as Genetic material, Chemistry of DNA, Modes of DNA Replication, Enzymes of DNA replication, Molecular mechanism of DNA replication, Differences in prokaryotic and eukaryotic DNA replication.

UNIT II

8 hours

DNA damage and recombination: Types of DNA damage - deamination, oxidative damage, alkylation and pyrimidine dimers; DNA repair – mismatch, short patch repair, nucleotide/base, excision repair, recombination repair and SOS repair. Molecular basis of mutation, Recombination; Site specific recombination, Homologous recombination, transposition

UNIT III

8 hours

Gene Expression: Structure of RNA- Classes of RNA, Chemistry of RNA. **Transcription:** Transcription in prokaryotes and eukaryotes, Eukaryotic transcription factors. RNA processing, Ribozymes, Antisense RNA, Inhibitors of transcription and their mechanism of action.

Translation: Role of ribosome and different types on RNA in protein synthesis, basic feature of genetic code, mechanism of initiation, elongation and termination, Translational control and post-translational events.

UNIT IV

8 hours

Regulation of Gene expression: Regulation of gene expression in prokaryotes. Regulation of gene expression in bacteriophages, eukaryotes. Gene regulation during development, gene silencing – gene regulation after transcription.

PRACTICALS

4X8=32 Hours

1. Preparation of stock solutions and working solutions for molecular biology practicals.
2. Isolation of Genomic DNA from *E. coli*.
3. Purification, concentration and quantification of DNA.
4. Determination of purity and concentration of isolated DNA using spectrophotometer.

5. Isolation of RNA and its quantification.
6. Salt fractionation of Yeast protein and quantification.
7. Separation of proteins by SDS PAGE.
8. Separation of aminoacids by paper chromatography.
9. Isolation and purification of plasmids from bacteria by agarose gel electrophoresis.
10. Determination of base ratios (Tm) in nucleic acids

References:

- Benjamin, L. 1990. Gene 4th edn. Oxford Univ. Press, Oxford.
- Brown, T. A. 1991. Essential Molecular Biology. A Practical Approach Vol-I & Vol.-II, Oxford Univ. Press. Oxford.
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- Lodish, H., Berk, A., Zipursky, S. A., Matsudaira, P., Baltimore, D. and Darnell, J. 1999. Molecular Cell Biology, W.H. Freeman and Company, New York.
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- Watson, J. D., Hopkins, N. H. - Molecular Biology of the gene 4th Edn. The Benjamin/Cummings Pub. Co. Inc. NY

MB 3.3 Hardcore: CLINICAL & DIAGNOSTIC MICROBIOLOGY

THEORY

32 Hours

UNIT I

8 hours

A) Introduction to clinical Microbiology: Role of Microbiologist in Diagnostic laboratory, General concepts for specimen collection, handling, transportation, processing, specimen workup, Laboratory safety and infection control.

B) Scientific and Laboratory basis for Clinical/Diagnostic Microbiology: Microscopic examination of infectious diseases, Growth and biochemical characteristics, Rapid methods of identification.

UNIT II

8 hours

A) Immunotechniques and Immunodiagnosis: Antigens and Antibody reactions *in vitro*; Agglutination, complement fixation, ELISA, Western Blotting Immunodiffusion, Immunoelectrophoresis, Immunofluorescence, Immunoprecipitation, Radioimmunoassay and serotyping.

B) Vaccines and Vaccination: Vaccines – definition, types, Antigens used as Vaccines, effectiveness of vaccines, Vaccine safety, current vaccines, adjuvants, active immunization and passive immunization.

UNIT III

8 hours

Recent Diagnostic tools and techniques: Principle, working and application of a) Autoanalyser b) Biosensor glucometer c) Diagnostic kits- ELISA, Western Blot d) Enzymes in Disease diagnosis and therapy: Lactate dehydrogenase, Aspartate aminotransferase, Alkaline phosphatase, Creatine kinase, Acid phosphatase, Cholinesterase.

UNIT IV

8 hours

Antimicrobial Chemotherapy: Development of chemotherapy; General characteristics of drugs and their testing; Mechanism of action. Antibacterial drugs; antifungal drugs, antiviral and antiprotozoan drugs; antibiotic sensitivity testing, MIC, Drug resistance; mechanism of drug resistance; multi drug resistance.

PRACTICALS

4X8=32 Hours

1. Collection of clinically important specimens, processing and identification of specimens.
2. Common stains used in Microbiology.
3. Microscopic examination of blood, fecus, CSF, other body fluids, pus (including drainage tube, catheter, ear, eye and genital swab).
4. Isolation and enumeration of Anaerobic bacteria from wound specimen.
5. Isolation and identification of Human pathogenic fungi and other opportunistic organisms.
6. Isolation and identification of microorganisms from sputum, throat, nose, ears swabs and urine samples.
7. Antimicrobial susceptibility testing and Serum Assay for Antimicrobial Content.
8. Conventional methods for bacterial identification- TSI, Catalase, Oxidase, Indole, Urease, Carbohydrate, PYR-Test, Urease strip test.
9. Detection of infectious diseases: RPR, WIDAL, HBsAG, HIV, Tuberculosis, Malaria, *Candida*, *Aspergillus*, *Cryptosporidium*.
10. Preparation of Antigens, control sera for serological tests.

Reference

- Brooks, G.F., Butel, J.S., and Ornston, L.N.1995. Jawetz, Melnick & Adelberg's Medical Microbiology, 20th ed, Stamford, Conn, Appleton & Lange.
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Rose, N.R., Macario, E., Fahey, J., Friedman, H., and Penn, G., editors. 1997, Manual of clinical laboratory immunology, 5th ed, Washington, D.C., American society for Microbiology.

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Turgeon, M.L., 1990. Immunology and serology in laboratory medicine, St.Louis, C.V. Mosby Co.

MB 3.4a Softcore: GENETIC ENGINEERING

THEORY

32 Hours

UNIT I

8 hours

A) Introduction to Genetic Engineering: Definition, concepts and scope of genetic engineering. Historical perspectives and milestones in Recombinant DNA Technology. Importance of gene cloning and future perspectives.

B) Tools in Genetic Engineering: Enzymes in genetic engineering. Cloning vectors: Ti Plasmid, pBR322, pUC –series. Phage vectors-M13 phage vectors, Cosmids-Types, Phasmids or Phagemids, Shuttle vectors. YAC and BAC vectors, Adenoviruses, Retroviruses, Synthetic construction of vectors, Ti cloning vector

UNIT II

8 hours

rDNA Technology: The basic principles of gene cloning strategies: Preparation, Manipulation and Insertion of desired DNA into vector. Introduction of DNA into host cells – Transformation, Transduction, Transfection, Microinjection, Biolistics, Electroporation, Liposome fusion. Shotgun cloning. Genomic and c-DNA Libraries. Cloning and expression in bacteria, yeasts, Identification and Selection of recombinants.

UNIT III

8 hours

A) Analysis of gene and gene products: Isolation and purification of nucleic acids, staining, DNA finger printing - RFLP,RAPD, DNA sequencing. Protein Sequencing. Blotting techniques- Southern, Northern and Western blotting techniques. PCR and its variants.

B) Microbial genome sequencing projects: DOE microbial genome programme, TIGR microbial database. Analysis of genome sequences, DNA chips: studying gene expression using DNA microarrays.

UNIT IV

8 hours

Applications of gene cloning and Ethics in Genetic Engineering: Applications of gene cloning in Biotechnology, Medicine, Agriculture, Forensic Science, Antisense technology. **Safety of recombinant DNA technology :** Restriction and regulation for the release of GMOs into Environment. Ethical, Legal, Social and Environmental Issues related to rDNA technology.

PRACTICALS

4X8=32 Hours

1. Estimation of DNA
2. Estimation of RNA
3. Estimation of protein by Lowry's method
4. Separation of amino acids by paper chromatography

5. Digestion of the gene of interest with suitable restriction enzymes.
6. Ligation of the digested gene in a vector.
7. Preparation of competent *E. coli* cells for Bacterial transformation.
8. Transformation of the vector into the host cell and selection of the desired clones.
9. Induction of gene expression and purification of the induced protein from the host.
10. Amplification, Purification and separation of PCR product.
11. Determination of DNase activity on isolated DNA.
12. Determination of RNase activity on isolated RNA.
13. Determination of Proteinase activity on proteins.
14. Demonstration of Western, Northern and Southern Blotting.
15. RFLP.

References:

- Boylan, M. and Brown, K.E. 2003. Genetic Engineering- Science and Ethics on the New Frontier. Pearson Education (Singapore) Pte. Ltd.,
- Brown, T.A. 2001. Gene Cloning and DNA Analysis-An Introduction 4th edn. Blackwell Science.
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- Ron Fridell. 2006. An Introduction to genetic engineering Lerner Publication company USA.
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- Winnacker, E. L. 1987. From Genes to Genomes. Introduction to Gene Technology. VCH. Weinheim.

MB 3.4b Softcore: Genomics and Proteomics

Unit - 01

Genome - Overview Of Genome; Sequence Of Genome Acquisition And Analysis - Homologies - Snps - Genetic Analysis, Linkage Mapping, High

Resolution Chromosome Mapping And Analysis - Physical Mapping, Yac, Hybrid Mapping, Strategies, Sequence Specific Tags (Sst), Sequence Tagged Sites(Sts), Ish, Fish, Rflp, Rapd.

Unit - 02

Dna Sequencing - Mdhods, Maxam And Gilbert Method, Ladder, Flourescent, Shot Gun, Mass Spectrometry, Automation Dequencing – Find Gene Mutations, Implications Of Dna - Sequencing And Sequening Genomes.

Unit - 03

Genome Data Bank, Metabolic Pathway Data - Construction And Screening Of Cdna, Libraries And Microarrays - Pplication Of Dna Arrays - Pcr - Variations In Pcr - Gene Distruptions - Sage And Sade, Pharmacogenomics.

Unit - 04

Protein Sequence Analysis - Introduction - Sequence Data Banks - Wbrf – Pir - Swissport - Databases, Data Mining - Algorithms Of Proteomics And Its Applications - Protein Expression Profilling - Protein - Protein Interaction - Protein Modifications. Automation - Nucleic Acid Data Bank – Embl Nucleotide Sequence Data Bank - Aids Virus Sequence Data Bank - Rna Data Bank.

Unit - 05

Tools For Data Bank - Pairwise Alignment - Needleman And Wusch Algorighm - Smith Waterman - Multiple Alignment - Clustral - Pras - Blast - Fast, Algorithms To Analyse Sequence Data - Pdb, Cambridge Structure Data Base (Lsd), 2d Electrophoresis, Ief, Hplc, Protein Digestion Technique, Mass Spectrometry, Maldi, Tof, Peptides, Mass Finger, Printing, Protein.

References

Brown T. A., Genomes

MB 3.7 OPEN.ELECTIVE: MICROBIAL TECHNOLOGY

THEORY

32

Hours

UNIT I

8

hours

Microscopy: Light microscopy- Simple microscopy (dissection microscope), Compound microscopy (Bright field, Dark field, phase contrast, and Fluorescence microscopy) and

stereomicroscopy. **Electron microscopy:** Principles, construction and mode of operation of scanning and Transmission electron microscopy, limitations. Preparation of specimens for electron microscopic studies (Ultra thin sectioning, negative staining, shadow casting and freeze etching).

UNIT II 8
hours

Microbiological stains and staining techniques: **Types of stains and principles of staining. Stains for bacteria, fungi, algae and protozoa, spirochetes, stains for azotobacter cysyts, stains for mycoplasma. Preparation of bacterial smears for light microscopy: Fixation, simple staining, Differential staining, Structural staining (Capsule, Flagella, Cell wall and Endospore of bacteria), and nuclear staining.**

UNIT III 8
hours

A) Culture media for Microbes Types of media- general purpose media, special purpose media- selective, elective, diagnostic, resuscitation media, Media for fungi, algae, bacteria, mycoplasma and viruses.

B) Sterilization techniques: Principles, types of Sterilization, and their mode of action. Physical methods: Heat-dry heat (Hot-Air oven), Incineration, Moist heat (Autoclave and Pressure cooker), Tyndalization (Fractional Sterilization), Filtration-Types of filters, Laminar airflow. Radiation methods (UV radiation, x-rays and cathode rays).

UNIT IV 8
hours

A) Control of Microorganisms: Chemical methods: Definition of terms- Disinfectants, Antiseptics, Sanitizers, Microbicides (bactericide, fungicide and Sporicide), Microbistatic (bacteristatic and fungi static agents). Use and mode of action of Alcohols, Aldehydes, Halogens, Phenols, Heavy metals, and Detergents.

B) Pure culture techniques: Different types of inoculation techniques - Spread plate, Pour plate and Streak plate methods.

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PRACTICALS

4X8=32

Hours

1. Microscopy
2. Isolation of Microbes
3. Culturing of Microbes
4. Staining of Microbes
5. Motility test
6. Spread and spore plate Technique
7. Antimicrobial activity
8. Effect of alcohol and detergents on microbes

SEMESTER IV

MB 4.1 Hardcore: MEDICAL MICROBIOLOGY

THEORY

32 Hours

UNIT I

8 hours

A) Introduction to Medical Microbiology: History, Development and scope of Medical Microbiology. Contributions of Ronald Ross, Robert Koch, Paul Ehrlich, Elie Metchnikoff, Nichole, Domagk, Alexander Fleming, Florey, Chain, Selman A. Waksman, Enders and Rous.

B) Microbial infections: Types of infections, modes of transmission, portal of entry: Urinary tract infection, Sexually transmissible infection, Infection of the central nervous system, Infections of circulatory system, Oral cavity and respiratory infection, Gastrointestinal infection.

UNIT II

8 hours

A) Nosocomial infection: Incidence of nosocomial infections, types of nosocomial infections, emergence of antibiotic resistant microorganisms, hospital infection control programmes, preventing nosocomial infections and surveillance, General concepts for specimen collection and handling of specimen, specimen processing and biosafety.

UNIT III

8 hours

Epidemiology, Pathogenesis, Spectrum of disease, Laboratory diagnosis and Prevention:

- a. **Diseases caused by Viruses:** Chicken pox, Rabies virus, hepatitis, encephalitis, AIDS, Herpes simplex infections, Influenza, Dengue
- b. **Diseases caused by Bacteria:** Tuberculosis, Leprosy, cholera, Typhoid, Botulism, Shigellosis, Helicobacter pylori infection, Salmonellosis, Tetanus.
- c. **Diseases caused by Fungi:** Candidiasis, Histoplasmosis, Blastomycosis, Coccidiomycosis, Dermatormycosis, Aspergillosis and Cryptococcosis, Anthrax

UNIT IV

8 hours

- a. **Diseases caused by Mycoplasma:** *Mycoplasma pneumoniae*, *M.urealyticum*, *M.homonis*.
- b. **Diseases caused by Protozoa:** Giardiasis, Trichomoniasis, Cerebral Malaria, Toxoplasmosis, Cryptosporidium.
- c. **Disease caused by Chlamydiae:** Psittacosis, Lymphogranuloma Venereum, Trachoma and Inclusion conjunctivitis.
- d. **Emergent Diseases:** Hemorrhagic fever, Swine flu, SARS, Chikun gunya, Ebola, Hanta, Leptospirosis, Marburg

PRACTICALS

4X8=32 Hours

1. Pathogenic fungi of the skin (Dermatophytes).
2. Microbial flora of mouth – teeth crevices.
3. Microbial flora of saliva.
4. Microorganisms of respiratory tract-examination of sputum/ AFB acid – fast bacteria.

5. Estimation of bacteria in urine by calibrated loop direct streak method.
6. Antimicrobial assay – sensitivity test (MIC) for pathogenic bacteria.
- 8-14. Laboratory diagnosis of important human diseases: Diphtheria, Tuberculosis, Typhoid, Wound infections, Malaria, Leprosy, AIDS and Hepatitis.

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MB 4.2a Softcore: INDUSTRIAL MICROBIOLOGY

THEORY **32 Hours**

UNIT I **8 hours**

Introduction: **Concepts and Scope. Modern era of industrial fermentation technology.**

Fermentation - concept and range of fermentation processes.

Industrial Microorganisms: **Screening, Isolation. Identification and characterization of industrially important microbes. Strain improvement- mutation, recombination- gene regulation and genetic manipulation. Preservation of industrially important microbes.**

Culture collection centers. Batch and Continuous fermentor.

UNIT II **8 hours**

A) Media for Industrial Fermentations: **Media formulation, growth factors, carbon, nitrogen, Energy and Mineral sources, buffers, inhibitors, precursors, inducers, Oxygen requirements Antifoam agents and others, Sterilization: Media and Fermenter sterilization-**

B) Down stream processing: **Steps in recovery and purification of fermented products. Solid matter, Foam separation, Precipitation, Filtration, Centrifugation, Cell disruption, Liquid- Liquid extraction, Solvent recovery, Supercritical fluid extraction,**

chromatography, Membrane processes, Drying, Crystallization, Whole broth processing. Effluent treatment, Industrial costing and economics of fermentations.

UNIT III

8 hours

A) Industrial production of energy fuels: **Industrial alcohol production: Importance of ethanol, biosynthesis , methods of production- recovery and applications of ethanol, Acetone-butanol production: Importance of acetone-butanol, biosynthesis, production process, recovery and application, production of glycerol through microbial process.**

B) Industrial production of Organic acids and Enzymes: Citric acid: **strains for citric acid production, biosynthesis, nutrient media, production process, product recovery and application.** Lactic acid: **Nutrient media, production process recovery and purification.**

Enzymes: **Production of Amylases-Fungal and Bacterial Amylase. Production of proteases: Alkaline proteases, Neutral proteases and acid proteases.**

UNIT IV

8

hours

A) Industrial production of food additives: **strains for amino acid production, methods of production production, process,; product recovery of L-Glutamic acid and L-lysine . Commercial uses of Amino acids Vitamins: Commercial production of Vitamin B₁₂, and Riboflavin.**

B) Industrial production of health care product: **Industrial production of β -lactum antibiotic (Penicillin): Biosynthesis, production and recovery. Streptomycin. Biosynthesis, production and recovery. I P R: Patents: Patent regulations of processes, products and microorganisms.**

PRACTICALS

4X8=32

Hours

1. Fermentor design and working principles.
2. Temperature, pH and gaseous analysis parameters.
3. Antifoam control device and detection of foam.
4. Roto meter and tachometer in the fermentor.
5. Sterilization of Fermentor/Media/air in a fermentor.
6. Batch and continuous sterilization process in a fermentor.
7. Primary inoculum development in a seed fermentor.
8. On-line measurement of a fermentation process.
9. Isolation of antibiotic/ amino acid/organic acid producing microbes and their preservation.

10. Batch fermentation of Citric acid production, recovery and estimation of citric acid.
11. Production of any vitamin and its quantification by bioassay.
12. Antibiotic fermentation and estimation of penicillin.
13. Preparation of wine and estimation of alcohol by specific gravity method.
15. Alcoholic fermentation and determination of total acidity and non-reducing sugars
16. Preparation of banana juice using Pectinase.
17. Culturing of *Chlorella* / *Spirulina*.
18. Visits to food industries, Dairy industries, Distilleries and Pharmaceutical industries and research laboratories. Student shall submit a report on the visits along with practical record for evaluation.

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MB 4.2b Softcore: AGRICULTURAL MICROBIOLOGY

THEORY	32 Hours
UNIT I	8 hours
Introduction to Agricultural Microbiology: , Introduction to agricultural microbiology, concepts and scope of agricultural microbiology, Agronomy and production of important crop plants, Green revolution. Plant Pathology: Concept of disease, History of Plant Pathology, Significance of plant diseases, Symptoms and types of plant diseases. Plant Pathology in Practice- Plant Clinic and Plant Doctor Concept. Diagnosis of Plant Diseases – Infectious diseases, Non-infectious diseases, Kochs' rules;	
UNIT II	8 hours
Parasitism and Disease Development Parasitism and pathogenecity, Host range of pathogens, Disease triangle, Diseases cycle / Infection cycle, Relationship between disease cycles and epidemics; Pathogens Attack Plants – Mechanical forces, Microbial enzymes and toxins, Growth regulators. Effect on physiology of Host – Photosynthesis, Translocation and transpiration, Respiration, Permeability, Transcription and translation. Environment and Plant Disease – Effect of Temperature, Moisture, Wind, Light, Soil, pH and structure, Nutrition and Herbicides. Defense Mechanisms of Plant Disease Pre-existing structural and chemical defenses, Induced structural and biochemical defenses;	
UNIT III	8 hours

Plant Disease & their management: Tobacco Mosaic Disease, Sandal Spike Disease, Bacterial blight of Paddy, Citrus canker, Angular leaf spot of cotton, Late Blight of Potato, Downy Mildew of Bajra, Blast of paddy, Tikka disease of ground nut, Rust of coffee, Grain and Head smut of Sorghum. Powdery mildew of Cucurbits, Wilt of Tomato, and Root Knot of Mulberry. Bunchy top of Banana.

UNIT IV

8 hours

Microbes and Plant interaction-Mycorrhizae-Biology and their applications, Biofertilizers - microbial inoculants. Production and application of *Rhizobium*, *Azospirillum*, *Azotobacter*, phospho bacteria and Cyanobacteria. PGPR's plant growth promoting *Rhizobacteria* and their uses. **Biopesticides:** Definition, types-bacterial, viral, fungal and protozoan, mode of action, target pests, use of transgenic plants. mode of action, Bacteria-endo and ecto-toxins production by *Bacillus thuringiensis*, *B* and *Pseudomonas*. Fungi- *Beauveria*, *Cephalosporium*, and *Trichoderma*.

PRACTICALS

4X8=32

Hours

1. Isolation, culturing and seed inoculation of *Rhizobium* and testing of nodulation ability and beneficial effects.
2. Isolation and testing the efficiency of various biofertilizers like *Rhizobium*, *Azotobacter*, *Azospirillum*.
3. Mass multiplication techniques of *Azolla*.
- 5-6. Recording environmental factors (Temperature, RH, Rainfall and wind velocity).
7. Splash liberation of spores from diseased tissue.
8. Estimation of total phenols in diseased and healthy plant tissues.
9. Seed health testing by SBM.
- 10-14. Collection and Identification of following disease: Tobacco mosaic disease, Bunchy top of Banana, Bean Mosaic, Sandal spike, Bacterial blight of paddy. Citrus canker, Downy mildew of Bajra, Powdery mildew of mulberry, Head smut of sorghum, Leaf rust of coffee, Blast disease of paddy, Tikka disease of groundnut, Leaf spot of paddy and Grassy shoot of sugarcane.

References:

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MB 4.3 Softcore: PRACTICAL VII

7. Pathogenic fungi of the skin (Dermatophytes).
8. Microbial flora of mouth – teeth crevices.
9. Microbial flora of saliva.
10. Estimation of bacteria in urine by calibrated loop direct streak method.
11. Laboratory diagnosis of important human diseases: Diphtheria, Tuberculosis, Typhoid, Wound infections, Malaria, Leprosy, AIDS and Hepatitis.
12. Fermentor design and working principles.
13. Temperature, pH and gaseous analysis parameters.
14. Antifoam control device and detection of foam.
15. Roto meter and tachometer in the fermentor.
16. Sterilization of Fermentor/Media/air in a fermentor.
17. Batch and continuous sterilization process in a fermentor.
18. Primary inoculum development in a seed fermentor.
19. On-line measurement of a fermentation process.
20. Isolation of antibiotic/ amino acid/organic acid producing microbes and their preservation.
21. Batch fermentation of Citric acid production, recovery and estimation of citric acid.
22. Preparation of wine and estimation of alcohol by specific gravity method.
23. Alcoholic fermentation and determination of total acidity and non-reducing sugars
24. Visits to food industries, Dairy industries, Distilleries and Pharmaceutical industries and research laboratories. Student shall submit a report on the visits along with practical record for evaluation.
25. Isolation, culturing and seed inoculation of *Rhizobium* and testing of nodulation ability and beneficial effects.
26. Isolation and testing the efficiency of various biofertilizers like *Rhizobium*, *Azotobacter*, *Azospirillum*.
27. Mass multiplication techniques of *Azolla*. Estimation of total phenols in diseased and healthy plant tissues. Seed health testing by SBM.
28. Collection and Identification of following disease: Tobacco mosaic disease, Bunchy top of Banana, Bean Mosaic, Sandal spike, Bacterial blight of paddy. Citrus canker, Downy mildew of Bajra, Powdery mildew of mulberry, Head smut of sorghum, Leaf rust of coffee, Blast disease of paddy, Tikka disease of groundnut, Leaf spot of paddy and Grassy shoot of sugarcane.