



KAKATIYA UNIVERSITY
M.Sc. Microbiology Syllabus
For the candidates admitted from the academic year 2016-2017
For University College and affiliated colleges

S. No	Paper Code	Title of Paper	Instruction Hours/week	No. of Credits	Marks		Total
					Internal Marks	External Marks	
Semester I							
1	MBT 101	Principles of Microbiology	4	4	20	80	100
2	MBT 102	Bacteriology & Virology	4	4	20	80	100
3	MBT 103	Biological Chemistry	4	4	20	80	100
4	MBT 104	Cell biology & Enzymology	4	4	20	80	100
5	MBP 105	Principles of Microbiology & Bacteriology & Virology	6	4	-	100	100
6	MBP 106	Biological Chemistry & Cell biology & Ezymology	6	4	-	100	100
7	MBS 107	Seminar	1	1		-	25
		Total		25			625
Semester II							
1	MBT 201	Microbial Physiology	4	4	20	80	100
2	MBT 202	Molecular Biology	4	4	20	80	100
3	MBT 203	Advanced Immunology	4	4	20	80	100
4	MBT 204	Biophysical Techniques & Instrumentation	4	4	20	80	100
5	MBP 205	Microbial Physiology & Molecular Biology	6	4	-	100	100
6	MBP 206	Adv. Immunol & Biophy. Tech. & Instrumentation	6	4	-	100	100
7	MBS 207	Seminar	1	1		-	25
		Total		25			625
Semester III							
1	MBT 301	Microbial Genetics & Genetic Engineering	4	4	20	80	100
2	MBT 302	Bioinformatics & Computational Methods	4	4	20	80	100
3	MBT 303 (A)	Bioprocess Technology	4	4	20	80	100
	MBT 303 (B)	Clinical Microbiology					
4	MBT 304 (A)	Agricultural Microbiology	4	4	20	80	100
	MBT 304 (B)	Dairy Microbiology					
5	MBP 305	Micro. Genetics & Genetic Engi. & Bioin. & Comp. Methods	6	4	-	100	100
6	MBP 306	Bioprocess Technology, Clinical Microbiology & Agri. Microbiology, Dairy Microbiology (any two combination from MBT 303 and MBT 304)	6	4	-	100	100
7	MBS 307	Seminar/Tutorials	1	1		-	25
		Total		25			625
Semester IV							
1	MBT 401	Environmental Microbiology	4	4	20	80	100
2	MBT 402	Medical Microbiology	4	4	20	80	100
3	MBT 403 (A)	Microbial Technology	4	4	20	80	100
	MBT 403 (B)	Pharmaceutical Microbiology					
4	MBT 404 (A)	Nanotechnol & Regulations of Microbial Products	4	4	20	80	100
	MBT 404 (B)	Waste Management Technology					
5	MBP 405	Environmental Microbiol. & Medical Microbiol.	6	4	-	100	100
6	MBP 406	Microbial Technology, Pharmaceutical Micbio. & Nanotech. & Reg. of Micro. Products and Waste Management Technology (any two combinations from MBT 403 and MBT 404)	6	4	-	100	100
7	MBS 407	Seminar/Tutorials	1	1		-	25
		Total		25			625

Semester – I
Paper –I
MBT-101: PRINCIPLES OF MICROBIOLOGY

Unit - I

- a. History and scope of Microbiology: Discovery of microorganisms, Germ theory of diseases; Major contributions and events in the field of microbiology. Relevance of Microbiology.
- b. Scope of Microbiology- Cycle of matter in nature. Microbial interactions - mutualism, symbiosis, commensalisms, predation, parasitism, amensalism and competition.
- c. Microbial Taxonomy: Definition and systematics, nomenclature rules, taxonomic ranks and major characteristics used in identification: morphological, physiological, biochemical, ecological, genetic and molecular. Numerical Taxonomy.
- d. Recent Trends in exploitation of microbial diversity. Community level physiological profile, fatty acid methyl esterase analysis, G+C ratio, nucleic acid reassociation and hybridization and DNA micro arrays.

Unit - II

- a. Details of the ultra structure of prokaryotic cell. Differences between Prokaryotic and Eukaryotic cells.
- b. Structure and functions of Cell Wall and Cell Membrane of Bacteria and Archea.
- c. Types of culture media, isolation, purification and preservation techniques.
- d. Microbial growth kinetics, growth measurements and factors effecting the growth.

Unit - III

- a. General characters, thallus organization, cell structure, reproduction and classification of fungi.
- b. Physiology of fungi: Growth, nutrition, reproduction, heterothallism, heterokaryosis.
- c. Parasexuality, sex hormones, spore dormancy and germination of fungi. General characters, reproduction, life cycles and economic importance of
 - i. Mastigomycotina - *Albugo*, *Perenospora*
- d. General characters, reproduction, life cycles and economic importance of
 - i. Zygomycotina - *Mucor*, *Pilobolus*
 - ii. Ascomycotina – *Penicillium*, *Neurospora*

Unit - IV

- a. Structure, reproduction, molecular and biotechnological aspects of yeasts.
- b. General characters, reproduction, life cycles and economic importance of
 - i. Basidiomycotina-*Puccinia*, *Agaricus*
 - ii. Deuteromycotina-General characters, classification.
- c. General characters, thallus organization, pigments, reproduction, classification and economic importance of green algae; diatoms, euglenoids.
- d. Morphology, reproduction and life cycles of *Trypanosoma*, *Plasmodium* and *Balantidium*.

Recommended Books

1. Sneath, P.H.A .and R.R. Sokal 1973 Numerical taxonomy .The Principles and Practice of Numerical Classification, San Francisco. W.H. Freeman
2. Sneath, P.H.A 1989 Analysis and Interpretation of sequence data for bacterial Systematic. The view of a Numerical taxonomist . *Syst.Appl.Microbiol.* 12:15-31
3. Woese,C.R.,Kandler,O. and M.L.Wheelis 1990 Towards a natural System of organisms: Proposal for the Domains Archea, Bacteria and Eucarya. *Proc. Nati, Acad, Sci.* ,87: 4576- 4570
4. Woese.C,R 1987 Bacterial evaluation, *Microbiological Reviews.* 51: 221-271
5. Madigan,M.T.,J.M.Mrtinko and J.Parker 2000 Brock Biology of Microbiology IX Ed .Prentice Hall International, Inc.

6. Balows, A.A.G. Thuper, M. Dworker, W. Harder, K.Schleifer 1991 The Prokaryotes , Springer, VerlogGunsales and Stainer, The Bacteria I-V vol. Academic press
7. Prescott, L.M., J.P Harley and D.AKlein, 2007 Microbiology VII Ed.Mc Grow Hill,
8. Davis R.Y. E.A. Adeberg and J.L. Ingram,1991 General Microbiology
9. Stainer General Microbiology, V Ed., Printice Hall of India Pvt,Ltd. New Delhi
10. Schaechter.R. and Ledenberg.J 2004 The desk encyclopedia of microbiology. Elsevier Academic Press California.
11. Cook .T 2002 Microbial Biodiversity saving bacteria to save ourselves, Harvard Sci. Review 26-28.
12. Vandanme,D. B.Pot, M.Gillis, P. Devos, K. Kersters and J. Swings.1996 Polyphasic taxonomy, a consensus approach to Bacterial Systematic, Microbiological Reviews. 407-438.
13. Bacterial (Prokaryotic) phylogeny web page. 2006, [http:](http://www.bacterial-phylogeny.com/Index.html)
14. [www.bacterial-phylogeny.com / Index .html.](http://www.bacterial-phylogeny.com/Index.html)
15. Brun,Y.V. and Schinketes 2000 Prokaryotic developments ASM press
16. Ronald M. Atlas 1997. Principles of Microbiology. II Ed. Mc Graw Hill Pub.
17. Talaro, K.P. and A. Talaro 1999 – Foundations in Microbiology. Mc Graw Hil. Pub.
18. Davies *et al.*,1990 Microbiology 4thEdition Philadelphia, JB Lippincott
- 19 Mehrotra RS and KR Aneja. An Introduction to Mycology, New Age Publishers
- 20 Alexopoulos CJ et al, Introductory Mycology 4th Edition
- 21 The Fungi: An Advanced treatise I-IV volumes (Ed) Ainsworth & Sussman; Academic Press.
22. Structure and Reproduction of algae FE Fritsch vol I & II
- 23 Fresh water algae of united States G. M. Smith
- 24 Introduction to the algae- Bold H.D and M.J. Wynne, Printice Hall.
- 25 Introductory Phycology – Trainor, F.R John Wiley, New York
- 26 Protozoology – Grell, Karl G .1973 Springer – Verlag, Heidelberg
- 27 The Biology of Protozoa – Sleight, MA American Elsevier, New York

Semester – I
Paper –II
MBT 102: BACTERIOLOGY AND VIROLOGY

Unit - I

- a. Systematic position of microorganisms in the living world. Classification of microorganisms: Haeckel's three kingdom concept, Whittaker's five kingdom concept. Three domain concept of Carl Woese.
- b. Historical account of bacterial classification systems and their utility – Archaea, Eubacteria.
- c. Detailed account of bacterial classification according to the 1st edition of Bergey's Manual of Systematic Bacteriology (up to sections).
- d. Detailed account of bacterial classification according to the 2nd edition of Bergey's Manual of Systematic Bacteriology (up to orders).

Unit - II

- a. Characteristics, classification and economic importance of the following sections (Bergey's Manual of Systematic bacteriology 1st edition). Spirochetes, Gram-negative aerobic rods and cocci: Facultative anaerobic Gram-negative rods, Rickettsia and Chlamydia.
- b. Mycoplasma, Endospore-forming Gram-positive rods and cocci; Mycobacteria, Anoxygenic photosynthetic bacteria.
- c. Oxygenic photosynthetic bacteria, Aerobic chemolithotrophic bacteria and Actinomycetes.
- d. Archaeobacteria: Evolutionary trends in relation to archaeobacteria, phylogenetic overview, properties of archaeobacteria and difference from eubacteria and eukaryotes.

Unit - III

- a. Brief account of discovery of viruses, Chemical composition, Morphology and Symmetry with reference to T4, TMV, Adeno, Influenza, Rhabo and HIV viruses.
- b. Subviral particles, Viroids, DI particles and Prions.
- c. Taxonomy of viruses: Classification and nomenclature of viruses as per ICTV.

- d. Isolation, Purification, Cultivation, Assay and Characterization of plant, animal and bacterial viruses.

Unit – IV

- a. Life cycles of bacterial viruses: One step growth curve, Lytic and Lysogenic cycles with reference to T4, λ Phage and ϕ X174.
- b. Replication patterns of specific plant viruses TMV and CaMV.
- c. Replication strategies employed by animal viruses: Herpes, Hepatitis, Adeno, Influenza and Retroviruses.
- d. Antiviral strategies, Prevention and control of viral diseases (Interferons, Antiviral drugs, Viral Vaccines).

Recommended Books

- 1 Sneath, P.H.A .and R.R. Sokal 1973 Numerical taxonomy .The Principles and Practice of Numerical Classification, San Francisco. W.H. Freeman
- 2 Sneath, P.H.A 1989 Analysis and Interpretation of sequence data for bacterial Systematic. The view of a Numerical taxonomist .*Syst.Appl.Microbiol.* 12:15-31
- 3 Tom Parker, M. Lerline , H.Collier,1990,Principles of Bacteriology, Virology and Immunity, VIII Ed.
- 4 Woese,C,R 1981 Archeobacteria , *Sci. Am.* 244:98-122
- 5 Woese,C.R.,Kandler,O. and M.L.Wheelis 1990 Towards a natural System of organisms: Proposal for the Domains Archea, Bacteria and Eucarya. *Proc. Nati, Acad, Sci.* ,87: 4576- 4570
- 6 Woese, C. R 1987 Bacterial evolution, *Microbiological Reviews.* 51: 221-271
- 7 Madigan, M. T.,J.M.Mrtinko and J.Parker 2000 Brock Biology of Microbiology IX Ed .Prentice Hall Inter, Inc.
- 8 Holt, J.G, and N.R.Krieg, 1984-1989 Bergey's Manual of Systematic Bacteriology 1st Ed (Vol 1-4) Williams and Wilkins Co Baltimore, Springer.
- 9 Holt , J.G, and N.R. Krieg, P.H .A .Sneath, J.T.Staley and J.T. Williams ,1994 Bergey's Manual Determinative Bacteriology IX Ed. Williams and Wilkins Co Baltimore, Springer
- 10 Garrity George, M. Edieor-In Cheaf 2005 Bergey's Manual of Systematic Bacteriology II Ed. (Vol- I-V) .J.Brenner,K.R.Krieg, J.T.Stanly. Editors. Springer-Verlog
- 11 Garrity, M. George. Winters, B.S.Denise 2001 Taxonomic outline of the prokaryotic genera Bergeys Manual of Systematic Bacteriology. II Ed.
- 12 Balous, A.A.G. Thuper, M. Dworker, W. Harder, K.Schleifer 1991 The Prokaryotes , Springer,
- 13 VerlogGunsales and Stainer, The Bacteria I-V vol. Academic press
- 14 Prescott, L.M., J.P Harley and D.AKlein, 2007 Microbiology VII Ed. Mc Grow Hill,
- 15 Davis R.Y. E.A. Adeberg and J.L. Ingram,1991 General Microbiology
- 16 Stainer General Microbiology, V Ed., Printice Hall of India Pvt,Ltd. New Delhi
- 17 Schaechter.R. and Ledenberg.J 2004 The desk encyclopedia of microbiology. Elsevier Acad. Press California.
- 18 Amann.R. I. Ludwing. W and Schleifer. K .M. 1995 Phylogenetic identification and in detection of individual microbial cell with cultivation. *Microbiological Reviews* 59, 143-169.
- 19 Cook .T. 2002 Microbial Biodiversity saving bacteria to save ourselves, Harvard Sci. Review 26-28.
- 20 Vandanme,D. B.Pot, M.Gillis, P. Devos, K. Kersters and J. Swings.1996 Polyphasic taxonomy, a consensus approach to Bacterial Systematic, *Microbiological Reviews.* 407-438.
- 21 Bacterial (Prokaryotic) phylogeny web page. 2006, [http: www.bacterial phylogeny.com / Index .html](http://www.bacterial_phylogeny.com / Index .html).
- 22 Brun,Y.V. and Schinketes 2000 Prokaryotic developments ASM press
- 23 Ronald M. Atlas 1997. Principles of Microbiology. II Ed. Mc Graw Hill Pub.
- 24 Talaro, K.P. and A. Talaro 1999 Foundations in Microbiology. Mc Graw Hil. Pub.
- 25 Davies *et al.*,1990 Microbiology 4thEdition Philadelphia, JB Lippincott
- 26 Alan J. Cann, 1997 Principles of Molecular Virology.(2nd edition).Academic Press, California.
- 27 Conrat HF, Kimball PC and Levy J.A. 1988 Virology. II edition. Prentice Hall, Englewood Cliff, New Jersey
- 28 Dimmock,N.J, Primrose,S. B.1994 Introduction to Modern Virology IV edition. Blackwell Scientific Pub, Oxford
- 29 Flint, S.J., Enquist, L.W., Krung, R. Racaniello, VR. and Skalka, A.M. (2004). Principles of Virology,ASM Press
- 30 Molecular Biology, Pathogenesis and Control, ASM Press, Washinton D.C.-
31. Roger Hull ,2002 Mathews' Plant Virology. (4thEdition). Academic press-A
32. Tom Parker, Leslie, M. and Collie, H.1990 Topley & Wilson's Principles of Bacteriology, Virology & Immunity (VIII Edition).
33. Ram Reddy S and Reddy S M. 2007 Essentials of Virology Scientific Publishers (India) Jodhpur

34. Knipe, DM *et al*(eds) 2001 Fields Virology Vol I , Lippincott Williams and Wilkins
35. Granoff,A and Webster R.G. 1999 Encyclopaedia of Virology Vol I, II and III San Diego Acad. Press
36. Krik.L.K. et al., 2004 Methods of studying soil microbial Diversity **58**: 169-188

Semester – I
Paper –III
MBT 103: BIOLOGICAL CHEMISTRY

Unit - I

- a. Carbohydrates: Structure, Characters and classification. Physico-chemical properties. Monosaccharide-functional isomers, ring structure, glycosides, derivatives of monosaccharide - amino sugars, sugar acids and phosphorylated sugars.
- b. Oligosaccharide-Disaccharides- sucrose, lactose and maltose. Trisaccharides-Raffinose, tetrasaccharide, stachyrose.
- c. Polysaccharides-Structure and occurrence (starch, cellulose, chitin, glycogen and peptidoglycan). Homoglycons, heteroglycons and conjugated glycons. Biological significance of polysaccharides.
- d. Functions of carbohydrates-Energy storage, structural elements, and metabolic intermediates. Carbohydrates as informational molecules.

Unit - II

- a. Amino acids – Structure and types of amino acids, Standard amino acids, nonstandard amino acids, peptide bond. D-amino acids, beta- and gamma-amino acids. Chemical properties and chemical synthesis of peptides.
- b. Classification of amino acids. Essential and non-essential amino acids. Analysis of mixtures of amino acids. Derivatives of amino acids.
- c. Proteins classification, Physico-chemical properties and biological functions of proteins. Structure organization-Primary, secondary, tertiary and quaternary structures and specificity of proteins, supramolecular assemblies of proteins, glycoprotein and proteoglycans..
- d. Structure and purification methods-Protein isolation, solubilities of proteins, chromatographic separation of proteins and electrophoresis. Characterization of proteins.

Unit - III

- a. Lipids - classification of lipids; physico - chemical properties, separation, distribution in nature, characterization and saponification and iodine number.
- b. Nomenclature, outline structure, properties and functions of glycerides, neutral lipids (waxes, fats and oils).
- c. Phospholipids, spingophospholipids and glycolipids. Steroids- steroid hormones, hormone precursors, plant sterols, ergosterol, stigmasterol and cholesterol.
- d. Properties of lipid aggregates-Micelles and bilayers, liposomes, bilayer dynamics. Biological membranes, fluid mosaic model of membrane structure. Important features of bacterial lipids.

Unit - IV

- a. Types and composition of purine and pyrimidine bases and their nomenclature, nucleosides, nucleotides and polynucleotides. Nucleic acids: Types of RNA and DNA their structure, properties and functions.
- b. Vitamins: Classification: Definition and general characteristics, classification of water vitamins structure and their biochemical properties.
- c. Vitamins: Classification of fat soluble vitamins, structure and their biochemical properties. Deficiency and human requirement of different vitamins.
- d. Porphyrins: Porphyrin nucleus and classification. Importance of metalloporphyrins occurring in nature-hemoglobin, chlorophyll. Bile pigments-chemical nature and their physiological significance.

Recommended Books

1. Voet Donald and Voet J.G .3rd Edition , Biochemistry John Wiley and sons INC
2. Zubay .G. Biochemistry- Wm.C.brown Publishers
3. White .D. 2000 The Physiology and Biochemistry of prokaryotes-Oxford Univ.press
4. Lehninger A.L.Cox and Nelson -2006,4th Edition, Principles of Biochemistry –CBS Publishers and Distribution Pvt.Ltd
5. Gottschalk .G.1985 Bacterial metabolism –Springer Verlag
6. Stryer .L.5th Edition –Biochemistry . W.H.Freeman and Co
7. Doelle H.W.1975 Introduction to bacterial metabolism –Academic press
8. Wilson. K. and Walker.J.2000 Principle and Techniques –Practical Biochemistry-Cambridge University press
9. Murray, Harpers Biochemistry Mc Graw Hill
10. White , Handler and Smith-Biochemistry
11. West and Todd –Biochemistry Mac Millan Publishers
12. Corn and Stumpf, 5th Edition-Outlines of Biochemistry-Wiley Eastern Publications.
13. Upadhyaya and Nath- Biophysical chemistry (Himalaya Publications)
14. Morrison –Physical Biochemistry (Oxford)
15. Satyanarayana and Chakrapani 3rd Edition-Biochemistry Books and Allied Publishers
16. Trevor Palmer 2004 Enzymes, Affiliated East-West Press Pvt .Ltd
17. Dixon and Webb –Enzymes
18. Mathews,C.K.,K.E.van Holde and K.G.Ahern 1997 Biochemistry, 3rd , Pearson Edu.Pvt. Ltd.
19. Rawn, J.D.2004 Biochemistry Panima Pub. Corporation.
20. Voet Donald,J.W.Voet and Ch.W.Pratt, 2006 Fundamentals of Biochemistry 2nd ED.Jhon Willey & Sons Inc.
21. David,E. Metzler,2006 Biochemistry 2nd Ed Academic Press
22. Willium, H. Elliott and Daphne ,C.Elliot, 2004 Biochemisry and Molecular Biology 2nd ED Oxford University Press

Semester - I Paper- IV

MBT 104: CELL BIOLOGY AND ENZYMOLOGY

Unit - I

- a. Principles of bioenergetics – Laws of thermodynamics, enthalpy, entropy, concept of free energy: chemical equilibriums; structure and energetics of ATP molecule and other high energy compounds, types of phosphorylation. Oxidation reduction reactions.
- b. Chemiosmotic hypothesis and proton motive force and energy transformations. Electron transport, oxidative phosphorylation, structure of ATP synthase; mechanism of ATP synthesis. Inhibitors and uncouplers
- c. Membrane structure and dynamics; diversity structure and physiology of membrane pumps, carriers and channels.
- d. Cell signaling pathways: Basic elements of signaling system; extracellular signal molecules, receptors-ion linked, G-protein linked and enzyme linked receptors; calcium and NO as intracellular messengers. Convergence, divergence and crosstalk among different signaling pathways.

Unit - II

- a. Cell cycle: Over view, phases of the cell cycle, cell growth and extra cellular signals, Regulations of cell cycle progression (cyclins and cyclin dependent kinases), cell differentiation and cell cycle check points.
- b. Cancer biology: Types of cancers-benign and malignant, carcinogens - physical, chemical and biological, carcinogenesis, metastasis and invasion, tumorigenesis.
- c. Cancer critical genes: Protoncogenes-oncogenes, tumor-suppressor genes (antioncogenes), p53 gene, telomeres and cancers.
- d. Apoptosis (Programmed Cell Death): Apoptosis pathways and molecular mechanism of apoptosis.

Unit - III

- a. Introduction and historical perspective of enzymes; properties, classification and nomenclature; structures and biological functions; theory of enzymatic catalysis, specificity. Concept of active site and enzyme substrate complex.
- b. Fisher's lock and key hypothesis, Koshland induced fit hypothesis, Haldane and Pauling concept.
- c. Enzyme kinetics: Effect of substrate concentration, derivation of Michaelis-Menten equation, K_s , K_m , V_{max} and K_{cat} and their significance, methods to determine K_m and V_{max} ; Briggs-Haldane steady state approach, Lineweaver-Burk plots, Eadie-Hofstee and Hanes plots.
- d. Enzyme inhibition – competitive, un-competitive, non-competitive, partial, substrate, allosteric. Isozymes-allosteric enzymes- ribozymes - abzymes.

Unit - IV

- a. Enzyme regulation: Product inhibition, feedback control, enzyme induction and repression and covalent modification, allosteric regulation, chemical modifications, calmodulin mediated regulation.
- b. Immobilization of enzymes: Methods of immobilization, ionic binding, adsorption, covalent bonding, micro-encapsulation and gel entrapment, membrane confinement; Practical and economic advantage for industrial use.
- c. Enzyme purification: Techniques of enzyme purification, assessment of purity, units of enzyme activity, recovery and yield of enzymes, characterization of enzymes.
- d. Enzyme stabilization by selection and genetic engineering, molecular graphics in protein engineering – Biosensors (glucose oxidase, cholesterol oxidase, urease and antibodies as biosensors).

Recommended Books

1. Getzenberg RH and EE Bittar, Cell Structure and Signaling, Elsevier Science.
2. Henderson et al., 1999 Cellular Microbiology.
3. Cossart et al., 2000 Cellular Microbiology
4. Phillip Sheeler and Donald E. Blanch Cell & Molecular Biology 3rd ED John Willey Pub.
5. Ernet, J.M. Helmreich, The Biochemistry of Cell Signaling, Oxford Press.
6. Cooper, The Cell.
7. De Roberts and De Roberts, 1998 Cell and Molecular Biology. Wavely Pvt. Ltd.
8. Voet and Voet J.G .3rd Edition , Biochemistry John Wiley and sons INC
9. Zubay .G. Biochemistry- Wm.C.brown Publishers.
10. White .D. 2000 The Physiology and Biochemistry of prokaryotes-Oxford Univ. Press.
11. Lehninger AL, Cox and Nelson -2006, 4th Edition, Principles of Biochemistry –CBS Pub.
12. Gottschalk .G.1985 Bacterial metabolism –Springer Verlag
13. Stryer .L. 5th Edition –Biochemistry. W. H. Freeman and Co
14. Doelle H.W.1975 Introduction to bacterial metabolism –Academic press
15. Wilson. K. and Walker.J. 2000 Principle and Techniques –Practical Biochemistry-Cambridge University Press.
16. Murray, Harpers Biochemistry Mc Graw Hill.
17. White, Handler and Smith-Biochemistry.
18. West and Todd –Biochemistry Mac Millan Publishers.
19. Wiley Eastern Publications.
20. Morrison –Physical Biochemistry (Oxford).
21. Satyanarayana and Chakrapani 3rd Edition-Biochemistry Books and Allied Publishers.
22. Trevor Palmer – Enzymes, 2004 Affiliated East-West Press Pvt .Ltd.
23. Dixon and Webb –Enzymes.
24. Pollard T D and Earnshaw W. C .2008 Cell Physiology 2nd ed Saunders, Elsevier.
25. Dawes, E. A. 1986 Microbial Energetics, New York: Chapman.
26. Albert *et al.*, Molecular Biology of cell. 4th Edition Garland Publishing Inc.
27. Karp Gerald 2008 Cell and Molecular Biology John Wiley &sons, Inc.
28. Lewin, B. 2004 Genes VIII. Oxford University Press, Oxford.
29. Principles of Biochemistry, 3rd Edition by Lehninger, Nelson & Cox.
30. White, D.1995 The Physiology and Biochemistry of Prokaryotes, Oxford University Press,
31. Boyer, P. D. 1997 .The ATP synthase- A splendid molecular machine. Ann. Rev.

Semester - I Practical Paper – I

MBP 105: PRINCIPLES OF MICROBIOLOGY & BACTERIOLOGY & VIROLOGY

1. Preparation of different types of media
2. Isolation and enumeration of bacterial and fungal population in air.
3. Enumeration of bacterial population in water.
4. Isolation and enumeration of bacterial and fungal population in soil
5. Demonstration of bacterial motility by Hanging drop technique
6. Staining techniques.
 - i) Gram staining
 - ii) Cell wall staining
 - iii) Endospore staining
 - iv) Flagella staining
 - v) Capsule staining
 - vi) Staining of PHB granules
 - vii) Staining of phosphate granules
7. IMVIC tests (Indole, methylred, Voges prausker and citrate test)
8. Oxidast test
9. Carbohydrate fermentation & Gas production
10. Catalase test
11. Gelatinase test
12. Caseinase test
13. Amylase test
14. H₂S production test
15. Nitrate reduction test
16. Litmus milk reactions
17. Urease test
18. Determination of bacterial growth by turbidometric method
19. Effect of temperature on bacterial growth.
20. Effect of osmotic pressure on bacterial growth.
21. Effect of p^H on bacterial growth
22. Cultivation of anaerobes
 - i) Shake culture technique
 - ii) Pyrogallic acid method
 - iii) Anaerobic gas pack jar
23. Growth kinetics (problems)
24. Estimation of chlorophyll in healthy and viral diseased plants
25. Study of symptomology of plant, animal and human diseases caused by viruses.
26. Estimation of proteins in healthy and viral diseased plants
27. Estimation of DNA in healthy and viral diseased plants
28. Estimation of RNA in healthy and viral diseased plants
29. Transmission of viruses by grafting
30. Transmission of viruses by aphids
31. Sap transmission of plant viruses
32. Isolation of phages from sewage
33. Propagation of animal viruses in embryonated eggs
 - a) Amniotic cavity
 - b) Chorioallantoic cavity
 - c) Yolk sac
34. Preparation of bacteriophage stocks
35. One step growth curve experiments.
36. Problems on i) Phage enumeration ii) Acid end point iii) Hemagglutination assay
37. Micrometry-measure the fungal spore dimensions by using ocular and stage micrometers and calculation of the mean and standard deviation
38. Demonstration of mycorrhizal association
39. Identification of fungal cultures, algal cultures, and Protozoa
40. Electron photo micrographic study of virus.

FACULTY OF SCIENCE
M.Sc. MICROBIOLOGY
Practical Examination
MBP 105: PRINCIPLES OF MICROBIOLOGY & BACTERIOLOGY & VIROLOGY

Semester - I

Question Bank

Paper - I

Time: 4 Hrs

Max. Marks: 100

1. Major Experiment

25 Marks

1. Micrometry-measurement of the fungal spore dimensions by using ocular and stage micrometers and calculation of the mean and standard deviation
2. Demonstration of mycorrhizal association
3. Demonstration of bacterial motility by hanging drop technique
4. Gram staining
5. Cell wall staining
6. Endospore staining
7. Flagella staining
8. Capsule staining
9. Staining of PHB granules
10. Staining of phosphate granules
11. Measurement of bacterial growth by turbidometric method

2. Major Experiment

25Marks

1. Estimation of chlorophyll in healthy and viral diseased plants
2. Study of symptomology of plant, animal and human diseases caused by viruses.
3. Estimation of proteins in healthy and viral diseased plants
4. Estimation of DNA in healthy and viral diseased plants
5. Estimation of RNA in healthy and viral diseased plants
6. Transmission of plant viruses by grafting
7. Transmission of plant viruses by aphids
8. Sap transmission of plant viruses
9. Isolation of coliphages from sewage

3. Minor Experiment

10 Marks

- | | |
|---|---|
| 1. Indole test | 14. Urease test |
| 2. Methyl red test | 15. Growth kinetics (problems) |
| 3. Voges Proskauer test | 16. Effect of osmotic pressure on bacterial growth. |
| 4. Citrate test | 17. Effect of p ^H on bacterial growth |
| 5. Oxidase test | |
| 6. Carbohydrate fermentation & Gas production | |
| 7. Catalase test | |
| 8. Gelatinase test | |
| 9. Caseinase test | |
| 10. Amylase test | |
| 11. H ₂ S production test | |
| 12. Nitrate reduction test | |
| 13. Litmus milk reactions | |

4. Minor Experiment

10 Marks

1. Cultivation of anaerobes by shake culture technique
2. Cultivation of anaerobes pyrogallic acid method
3. Cultivation of anaerobes by anaerobic gaspak jar system
4. Propagation of animal viruses in amniotic cavity of embryonated eggs
5. Propagation of animal viruses in chorioallantoic cavity of embryonated eggs
6. Propagation of animal viruses in yolk sac of embryonated egg
7. Preparation of bacteriophage stocks
8. One step growth curve experiments.
9. Problems on phage enumeration
10. Problems on acid end point
11. Problems on hemagglutination assay of viruses

5. Spotters Identification (4 Nos)

20 Marks

(Viruses = 1; Fungi = 1; Algae = 1; Protozoa = 1)

1. **Viruses**
 - a) Electron photomicrographic study: TMV, T₄ phage, λ-phage Mu phage, φ174 Phage adsorption to *E. coli*, Adenovirus, Influenza virus
 - b) Symptomology; Small pox, FM disease, Tulip break, Leaf curl of papaya, Chilli mosaic, Phage plaques, pocks, animal virus plaques in monolayer cell culture, Golden yellow mosaic of beans.
2. **Fungi** : *Rhizopus, Mucor, Penicillium, Aspergillus, Alternaria, Curvularia, Nigrospora, Phoma, Fusarium, Rhizoctonia, Chaetomium, Pestalotiopsis.*
3. **Algae** : *Nostoc, Scytonema, Oscillatoria, Anabaena, Spirulina, Volvox, Scenedesmus*
4. **Protozoa** : *Trypanosoma, Giardia, Balantidium, Leishmania, Entamoeba histolytica, Plasmodium, Peramoecium* (permanent slides)
5. **Photographs of eminent microbiologists & their contributions**

6. Record

10 Marks

Semester - I

Practical Paper - II

MBP 106: BIOLOGICAL CHEMISTRY & CELL BIOLOGY AND ENZYMOLOGY

1. Preparation of buffers, titration curve of glycine
2. Quantitative estimation of glucose by Anthrone method
3. Quantitative estimation of reducing sugars by 3,5, DNS method
4. Quantitative estimation of fructose
5. Quantitative estimation of proteins by Lowry's method
6. Quantitative estimation of Indole Acetic Acid
7. Quantitative estimation of Ascorbic acid
8. Quantitative estimation of Amino acid
9. Qualitative test of carbohydrates: Glucose, Xylose, Starch, Lactose, Maltose, Sucrose
10. Qualitative test of amino acids: Tryptophan, Tyrosine, Methionine, Arginine, Proline,
11. Qualitative test of proteins: Gelatin, Globulin, Albumin, Peptone, Casein
12. Determination of iodine number of fat
13. Qualitative test of lipids: Cholesterol
14. Demonstration of mitosis cell division stages
15. Demonstration of meiotic cell division stages
16. Evolution of kinetic constant of the purified enzyme.
17. Effect of different parameters on enzyme activity such as pH, temperature, time, enzyme concentration
18. Effect of inhibitors on enzyme activity

19. Immobilization of enzyme
20. Enzyme purification
21. Peroxidase isozyme separation by gel electrophoresis
22. Estimation of arginase activity
23. Estimation of catalase activity

**FACULTY OF SCIENCE
M.Sc. MICROBIOLOGY
Practical Examination**

MBP 106: BIOLOGICAL CHEMISTRY & CELL BIOLOGY AND ENZYMOLOGY

Semester – I

Question Bank

Paper - II

Time: 4 Hrs

Max. Marks: 100

1. Major Experiment

25Marks

1. Preparation of buffers, titration curve of glycine
2. Quantitative estimation of glucose by Anthrone method
3. Quantitative estimation of reducing sugars by 3,5 DNS method
4. Quantitative estimation of fructose
5. Quantitative estimation of proteins by Lowry's method
6. Quantitative estimation of Indole Acetic Acid
7. Quantitative estimation of Ascorbic acid
8. Quantitative estimation of Amino acids
9. Determination of iodine number of fat

2. Major Experiment

25 Marks

1. Demonstration of mitotic cell division stages
2. Demonstration of meiotic cell division stages
3. Enzyme purification –Ammonium sulphate precipitation
4. Estimation of arginase activity
5. Estimation of catalase activity
6. Evaluation of kinetic constant of the purified enzyme.
7. Immobilization of enzyme

3. Minor Experiment

10 Marks

1. Qualitative test of carbohydrates: Glucose, Xylose, Starch, Lactose, Maltose, Sucrose
2. Qualitative test of amino acids: Tryptophan, Tyrosine, Methionine, Arginine,
3. Qualitative test of proteins: Gelatin, Globulin, Albumin, Peptone, Casein
4. Qualitative test of lipids: Cholesterol

4. Minor Experiment

10 Marks

1. Mitosis cell division stages
2. Meiotic cell division stages
3. Influence of PH on enzyme activity
4. Influence of temperature on enzyme activity
5. Influence of time on enzyme activity
6. Influence of enzyme concentration on enzyme activity
7. Influence of enzyme inhibitors on enzyme activity.

5. Spotters Identification (4 Nos)

20 Marks

1. Structures of monosaccharides
2. Structures of oligosaccharides

3. Structures of polysaccharides
4. Structures of amino acids
5. Structures of proteins
6. Structures of lipids
7. Structure of a typical chromosome
8. Heterochromatin in metaphase
9. Giant chromosomes
10. Polytene chromosome
11. Lampbrush chromosome
12. Cell cycle
13. Interphase
14. Prophase
15. Metaphase
16. Anaphase
17. Telophase
18. Leptotene
19. Zygotene
20. Pachytene
21. Diplotene
- 22. Diakinesis**
23. Immobilised cells
24. Lock and key model
25. Allosteric inhibitors
26. Competitive enzyme activity
27. Un- Competitive enzyme activity
28. Non-Competitive enzyme activity
29. Isozyme Patterns
30. L-B Plots
31. Photographs of cell biology scientists

6. Record

10 Marks

Semester – II
Paper – I
MBT 201: MICROBIAL PHYSIOLOGY AND METABOLISM

Unit – I

- a. Nutritional diversity in microorganisms, nutritional types - autotrophy, heterotrophy, chemotrophy, phototrophy, lithotrophy and organotrophy. Nutrition –essentiality of major and minor elements, growth factors.
- b. Uptake of nutrients: passive diffusion, facilitated diffusion, active transport, group translocation, iron transport–siderophores.
- c. Chemotrophism: (sulphur, ammonia, nitrite, iron, hydrogen, carbon monoxide oxidizers) and their importance, reverse electron transport, CO₂ assimilation, reductive acetyl COA pathway.
- d. Chemoheterotrophism: Acetogens, Methanogens, Methanogenesis and its importance. Physiology and economic importance of methylotrophs.

Unit – II

- a. Phototrophism: Oxygenic and anoxygenic phototrophs and their diversity, photosynthetic pigments and their light absorption, basic photochemistry of PSI, PSII and light driven electron transport.
- b. Modes of CO₂ fixation (Calvin cycle, reverse TCA cycle, HP pathway), Halobacterial photosynthesis. Anaplerotic reactions.
- c. Carbohydrate metabolism – various pathways underlying the utilization of different sugars (EMP, ED, HMP, phosphoketolase pathway) in microorganisms. Gluconeogenesis and its significance.
- d. Outlines of inter relationship between carbohydrate, protein and lipid metabolisms.

Unit – III

- a. Aerobic respiration: TCA cycle- intracellular location and reactions, amphibolic reactions. Glyoxalate cycle. Mechanisms of substrate–level phosphorylation. Respiratory electron transport in mitochondria and bacteria. Mechanism of oxidative phosphorylation.
- b. Anaerobic respirations: sulphate, nitrate, carbonate respirations and their ecological significance.
- c. Fermentations: Types of fermentations, alcoholic, lactate, propionate, mixed acid, butyrate and butanol fermentations and their industrial importance.
- d. Concepts of primary and secondary metabolisms. Biosynthesis of secondary metabolites with special reference to penicillin and polyketides, biotransformations, Bioluminescence, quorum sensing and signal transduction pathways.

Unit – IV

- a. Lipid metabolism: Biosynthesis of glycerols, phospholipids, glycolipids and fatty acids. Cholesterol biosynthesis. Oxidation of saturated and unsaturated fatty acids.
- b. Amino acid metabolism: Assimilation of inorganic nitrogen and sulphur. Biosynthetic pathways of amino acids and their regulation with emphasis on tryptophane and histidine. Porphyrine biosynthesis.
- c. Catabolism of aminoacids: Transamination, decarboxylation and deamination. Degradation of proteins-proteases, exo- endo peptidases.
- d. Nucleotide metabolism: Biosynthesis of purine and pyrimidine nucleotides-salvage and *denovo* pathways. Biosynthesis of deoxyribonucleotides and regulation. Catabolism of nucleotides.

Recommended Books

1. Caldwell, D.R. 1995 Microbial Physiology and Metabolism, Wm. C. Brown Publishers, USA
2. Lansing M. Prescott, John P. Harley and Donald A. Klein. 2007 Microbiology (5th edition). McGraw-Hill Company, New York.
3. Larry McKane and Judy Kandel. 1996 Microbiology-Essentials and applications. (2nd edition). McGraw Hill, Inc., New York.
4. Moat, A.G. and Foster, J.W. 1988 Microbial Physiology (Second Edition). John Wiley & Sons,
5. Pelczar Jr, M.J. Chan, E.C.S., Kreig, N.R. 1993 Microbiology, Mc. Graw Hill. Inc, New York.
6. Salle, A.J. 1996 Fundamental principles of Bacteriology (7th edition). Tata McGraw-Hill publishing company limited, New Delhi.
7. White, D. 1995 The Physiology and Biochemistry of Prokaryotes, Oxford University Press,
8. S. Ram Reddy and S.M. Reddy, 2006 Microbial Physiology, Scientific Pub, Jodhpur
9. Donald Voet and Judith G. Voet, 1995. Biochemistry – Second Edition. John Wiley and Sons,
10. Lubert Stryer. 1995. Biochemistry. (4th edition). W.H. Freeman and company, New York
11. Zubay, G. 1998 Biochemistry WCB. Mc Graw – Hill, Iowa.
12. Principles of Biochemistry, 3rd Edition by Lehninger, Nelson & Cox
13. Harper's Review of Biochemistry by Martin, Mayer & Rodwell
14. Smith, Hill, Lehman, Lefkowitz, Handler & White. Principles of Biochemistry: General aspects
15. Outlines of Biochemistry (5th edition) Conn, Stumpf, Bruening & Doi.
16. Gottschalk G. 1986 Bacterial Metabolism 2nd ed. New York : Springer – Verlag.
17. Dawes, I.W., Sutherland, I.W. 1992 Microbial Physiology 2nd ed London: Blackwell scientific Publishers

Semester – II

Paper – II

MBT 202: MOLECULAR BIOLOGY

Unit – I

- a. Chromosome organization in prokaryotes and eukaryotes.
- b. DNA replication: General principles, enzymes involved in DNA replication, various models of replication (semi conservative, rolling circle, unidirectional and bidirectional). DNA synthesis by reverse transcription, inhibitors of DNA replication.
- c. DNA damage: Types of damage (deamination, oxidative damage, alkylation, and pyrimidine dimers).
- d. DNA Repair pathways: Methyl-directed mismatch repair, very short patch repair, nucleotide excision repair, base excision repair, recombination repair and SOS system.

Unit – II

- a. Structural features of rRNA, tRNA and mRNA and their functions.
- b. Transcription: General principles, basic apparatus, RNA polymerases, promoters, enhancers and other regulatory sequences.
- c. Mechanism of transcription and inhibitors of transcription in prokaryotes and eukaryotes.
- d. Post-transcriptional modifications: Transcriptional attenuation, cutting and trimming of rRNA, mRNA modifications (capping, polyadenylation and splicing), cutting and modification of tRNA, catalytic RNA, group I and group II intron splicing and RNase P.

Unit – III

- a. Translation: Basic features of genetic code, Wobble concept, prokaryotic and eukaryotic ribosomes.
- b. Details of translation: Initiation, elongation and termination, factors that control the translation, inhibitors of protein synthesis.
- c. Post-translational modifications: Chemical modifications of proteins, proteolytic degradation, Intein splicing and protein folding.
- d. Protein sorting and targeting: Signal hypothesis-signal sequences, signal recognition particle and role of molecular chaperones in protein folding and targeting.

Unit – IV

- a. Regulation of gene expression: Operon concept, regulatory elements of operon - inducers, apo-repressors and co-repressors, positive and negative regulations, catabolite repression and regulation attenuation.

- b. Detailed account of structure, function and regulation of *lac* operon, *trp* operon and *ara* operon.
- c. Global regulatory responses: Heat shock response, stringent response, SOS response and Regulation by small molecules such as ppGPP, pppGPP and cAMP.
- d. Hormone and Environmental factors affecting gene expression, coordinate regulation of unlinked genes. Regulatory RNA.

Recommended Books

1. Brown, T.A. 1999 Gene Cloning. 3rd edition. Chapman and Hall Publications, USA.
2. Burrell, M.M. 1993. Enzymes of Molecular Biology, Humana Press.
3. Chirikjian, J.G. 1995 Biotechnology – Theory and Techniques, Vol. II, Jones and Bartlett Publishers.
4. Gerhardt, P. Murray, R.G., Wood, W.A., and Kreig, N.R. 1994 Methods for General and Molecular Bacteriology, ASM Press, Washington D.C.
5. Glick, B.R. and Pasternak, J.J. 1998 Molecular Biotechnology – Principles and Applications of Recombinant DNA, ASM Press, Washington D.C.
6. Lewin, B. 2008 Genes IX. Oxford University Press, Oxford.
7. Murray Moo 1992 Plant Biotechnology. Young, Pergamon Press.
8. Ratledge, C. and Kristiansen, B. 2001 Basic Biotechnology, II Edition, Cambridge University Press.
9. Winnacker, E.L. 1987 From genes to Clones: Introduction to Gene technology. V C H Publications, Federal Republic of Germany.
10. Antony, J.F., Griffiths, Gilbert, W.M., Lewontin, R.C. and Miller, J.H. 2002 Modern genetic analysis, Integrating Genes and Genomes, 2nd edition, WH Freeman and Company, New York.
11. Blackburn, G.M. and Gait, M.J. 1996 Nucleic acids in chemistry and biology. Oxford University Press.
12. Molecular Biology of cell. Albert *et al.*, 4th Edition Garland Publishing Inc.
13. Maloy, S.R., Cronan, J.R. Freifelder, D. 1994 Microbial Genetics, Jones and Bartlett Publishers.
14. Macinski, G.M. and Freifelder, D. 1998 Essentials of Molecular Biology, 3rd Ed, John and Bartlett Publishers.
15. Sir John Kendrew 1994 The Encyclopedia of Molecular Biology. Blackwell Science Ltd
16. Watson, J.D., Hopkins, N.H., Roberts, J.W., Steitz, J.A. and Weiner, A.M. 1998 Molecular Biology of the Gene, 4th edition, Benjamin/Cummings publishing company.
17. Freifelder, D. 1997 Essentials of Molecular Biology. Narosa Publishing House, New Delhi.
18. Freifelder, D. 1990 Microbial Genetics. Narosa Publishing House, New Delhi.
19. Snyder, L. and Champness, W. 1997 Molecular Genetics of Bacteria. ASM press, USA.
20. Maloy, S.R., Cronan, J.E. and Freifelder, D. 1994 Microbial Genetics, Jones and Bartlett Publishers, London.
21. Turner, P.C., Mclennan, A.G., Bates, A.D. and White, M.R.H. 1998 Instant Notes in Molecular Biology, Viva Books Pvt., Ltd., New Delhi.
22. Twynan, R.M. 2003 Advanced Molecular Biology. Viva books Pvt. Ltd. New Delhi.
23. Ram Reddy S, Venkateswarlu K and Krishna Reddy V 2007 A Text Book of Molecular Biotechnology Himalaya Publishers Hyderabad
24. Old, R.W. and Primrose, S.B. 1994 Principles of Gene Manipulation, Blackwell Science Publication.

Semester – II
Paper – III
MBT 203: ADVANCED IMMUNOLOGY

Unit – I

- a. History and scope of Immunology, Haematopoiesis, structure and function of cells and organs involved in immune system.
- b. Types of immunity (innate and acquired, active and passive) Immune response (Cell mediated and Humoral response).
- c. Immunohaematology: Blood groups, blood transfusion, Rh-incompatibility.
- d. Antigens: Antigen types, haptens, epitopes, adjuvants, Antigen specificity. Antibodies: Immunoglobulins structures, distribution and function. Theories of antibody production.

Unit – II

- a. Immunological reactions: *In vitro* methods: Agglutination, Precipitation, Complement fixation, Immunofluorescence, ELISA and RIA.
- b. *In vivo* methods: Phagocytosis, Opsonization and Neutralization.
- c. Complement components, complement activation pathways (Classical, Alternative and Lectin pathways).
- d. Regulation of complement system, biological consequences of complement, and complement deficiencies.

Unit – III

- a. Transplantation immunology: Structure and functions of MHC (Major histo-compatibility complex).
- b. HLA tissue typing and Organ transplantation (graft versus host reaction and rejection).
- c. Tumor Immunology: Tumor antigens, Host immune response to tumors.
- d. Tumors escape mechanisms, immunodiagnosis of tumors and immuno-therapy of tumors.

Unit – IV

- a. General account of immuno deficiency disorders: Primary and Secondary Immunodeficiency. Phagocytic cell disorder, Autoimmunity and autoimmune disorders.
- b. Hypersensitivity reactions: Type-I, II, III and IV and their respective diseases. Immunological methods of their diagnosis.
- c. Hybridoma technology for synthesis of monoclonal antibodies and their applications. Recombinant antibodies.
- d. Types of Vaccines: whole organism vaccines, Recombinant vaccines, DNA vaccines, synthetic peptide vaccines, Subunit vaccines, Immunization procedures.

Recommended Books

1. Bellanti. J.A. 1985 Immunology III Ed.
2. Coleman, R.M. Lambard, M. F. and Siccard, 1992 Fundamental of Immunology II Ed.
3. Kuby, J. 2004 Immunology VI Ed. W.H. Freeman and Company New York.
4. Poul, W.E. 1990 Fundamental of Immunology II Ed. Rava Press, New York.
5. Riott. M.Ivan 1998 Essential Immunology VII Ed. ELBS and Black well Scientific Pub. .
6. Tizarrd. I.R. 2004 Immunology an Introduction II Ed. Thomson Asia Pvt. Ltd
7. Ross. G.D. Immunology of the complement System
8. Riott, J.M. Brostoff, J.J and Male D.K. 1996 Immunology IV Ed. CV Mos by Pub. St. Loius.
9. Johnstone, A. and R. Thrope Immuno Chemistry.
10. Weir, Hand Book of experimental Immunology Voll,II
11. Stiter, Terr and Parlow Basic and Clinical Immunology
12. Tom Parker, M.Lesline, H.Collier, 1990 Principles of Bacteriology, Virology and Immunity.VII Ed.
13. Chapel, H. and Halbey, 1986 Essentials of clinical Immunology ELBS London.
14. Donald M. Weir, John Steward, 1993 Immunology VII Ed. ELBS, London.
15. Hue Davis, 1997 Introductory Immunology Champman and Hall Publisher.
16. Peter, J Delves, Ivan M. Roit Ed 1998 Encyclopedia of Immunology II Ed. Acad, Press.
17. Ridklad, M. Aydl, 1995 Immunology II Ed. Baltimore, Hangkang, NMS Pub.
18. Janeway, C. 2004 Immunology VI ED, Garland Science. New Yark.

Semester – II
Paper – IV
MBT 204: BIOPHYSICAL TECHNIQUES & INSTRUMENTATION

Unit – I

- a. Buffers: Henderson and Hesselbach equation, P_{ka} and P_{kb} . Preparation of buffers, measurement of pH, types of electrodes. Viscosity: specific, intrinsic and reduced viscosities, viscometers, determination of molecular size and shape through viscosity.
- b. Osmosis: Osmosis in relation to molecular size and molecular weight, osmometer; Dialysis, Membrane filtration and application.
- c. Microscopy: Phase contrast, Fluorescence microscopy, Electron microscopy- Transmission and Scanning electron microscopes (TEM & SEM).
- d. Cell and tissue culture techniques: Primary and secondary/established cell lines, Monolayer & suspension cultures.

Unit – II

- a. Centrifugation techniques: Basic principles of centrifugation, standard sedimentation coefficient and measurement of sedimentation coefficient.
- b. Analytical and preparative centrifugation, differential, rate zonal and equilibrium density gradient centrifugation. Applications in determination of molecular weight.
- c. Chromatography: General principles. Types - partition, adsorption; paper and thin layer chromatography.
- d. Column chromatography, HPLC, GLC, Gel filtration, Ion exchange chromatography and Affinity chromatography.

Unit – III

- a. Electrophoresis: General principles, Types - moving boundary electrophoresis, paper electrophoresis, cellulose acetate, starch gel electrophoresis, polyacrylamide electrophoresis and agarose gel electrophoresis.
- b. Pulse-field gel electrophoresis, horizontal and vertical electrophoresis, two-dimensional electrophoresis, immune-electrophoresis, iso-electric focusing electrophoresis, capillary electrophoresis. Blotting techniques -Southern, northern and western blottings.
- c. Radioisotopic techniques: Principle and applications of tracer techniques in biology. Radioactive isotopes, Radioactive decay.
- d. Detection and measurement of radioactivity, Geiger-Muller counter, scintillation counter, Autoradiography, tracer techniques, commonly used isotopes in biology, labeling procedures and safety aspects.

Unit – IV

- a. Spectroscopic techniques: Principle, simple theory of absorption of light by molecules, electromagnetic spectrum.
- b. Spectroscopy: The two most important tools used in nanotechnology research – Infrared spectroscopy and Raman spectroscopy.
- c. Instrumentation: Measuring the absorption and application of UV-visible spectrophotometer, Fluorescence spectroscope.
- d. Instrumentation: Measuring the absorption and application of NMR, ESR and Mossbauer spectroscopic method.

Recommended Books

1. Hames, B.D. and Rickwood, D. 1990 Gel Electrophoresis A Practical Approach, Oxford University Press, New York.
2. Westermeier, R. 1993 Electrophoresis in practice VCH, Federal Republic of Germany.
3. Cotterill, R.M J. 2002 Biophysics An Introduction, John Wiley and Sons England.
4. Harrett, R.H. and Grisham C...M, 2004 Biochemistry III Ed. Cole publishing co. California.
5. Nolting, B. 2006 Methods in Modern Biophysics II Ed. Springer, Germany.
6. Pattabhi, V. and Goutham .N.2002 Biophysica Kluwer Academic Pub. New York

7. Wilson Keith and Walker John 2005 Principles and Techniques and Biochemistry and Molecular Biology VI Ed. Cambridge University press, New York.
8. Narayana .P. 2000 Essentials of Biophysics New Age International Pub. New Delhi.
9. Stephenson, F.H. 2003 Calculation in molecular biology and biotechnology Academic Press, Elsevier Science .London.
10. Keeler, J.2002 Understanding NMR spectroscopy. John Wiley and Sons England.
11. Cavangh John et al 1995 Proton NMR, Spectroscopy principles and practice, Academic Press.
12. Holme. D.J. and H. Peck. Analytical Biochemistry.
13. A.Upadhyay, K.Upadhyay and N. Nath 2006 Biophysical Chemistry, Principles and Techniques Himalaya Pub. House.
14. Slater, R.J. 1991 Radioisotopes in Biology. A practical Approach, IRL Press, Oxford.
15. Holler, F.J.,D.A.Skoog and S.R.Crouch, 2007 Principles of Instrumental Analysis IV ED.Thomson, Brooks/Cole Pub. US
16. Richard Brooker and Earl Boysen (2006). Nanotechnology. Wiley Publishing Inc., India. Pp 361

Semester – II
Practical Paper – I
MBP 205: MICROBIAL PHYSIOLOGY & MOLECULAR BIOLOGY

1. Bacteria growth curve
2. Growth of the bacteria at different PH
3. Effect of different temperatures
4. Effect of osmotic pressure
5. Isolation of photosynthetic bacteria from sewage water
6. Estimation & characterization of bacterial chlorophylls
7. Enrichment cultivation of photosynthetic bacteria – Winogradsky column
8. Cultivation of anaerobic bacteria:
 - i) Shake culture technique ii) Pyrogallic acid
 - iii) Candle method iv) Liquid paraffin method v) Gaspak jar method
9. Determination of Thermal death time.
10. Biochemical tests for identification of bacteria:
 - i) Phenylalanine test ii) Digestion of casein
 - iii) Digestion of meat iv) Starch hydrolysis
11. Carbohydrate catabolism by microorganisms through oxidation and fermentation of glucose.
12. Enrichment cultures of sulphate reducing bacteria
13. Estimation of ethanol in fermentation broth.
14. Estimation of lactic acid in fermentation broth.
15. Estimation of DNA by DPA method
16. Estimation of RNA by orcinol method
17. Determination of purity of DNA
18. Isolation of RNA from plant sample
19. Isolation of RNA from viral infected plant sample
20. Isolation of DNA from sheep Liver/yeast/*E. coli*
21. Problems on DNA characteristics
22. Problems related to Transcription, Genetic code, Translation and Gene regulation.

FACULTY OF SCIENCE
M.Sc. MICROBIOLOGY
Practical Examination
MBP 205: MICROBIAL PHYSIOLOGY & MOLECULAR BIOLOGY
Semester – II Question Bank Paper – I

Time: 4 Hrs

Max. Marks: 100

1. Major Experiment **25 Marks**

1. Bacteria growth curve
2. Growth of the bacteria at different PH
3. Effect of different temperatures
4. Effect of osmotic pressure
5. Isolation of photosynthetic bacteria from pond water
6. Estimation and characterization of bacterial chlorophylls
7. Estimation of ethanol in fermentation broth.
8. Estimation of lactic acid in fermentation broth.

2. Major Experiment **25 Marks**

1. Estimation of DNA by DPA method
2. Estimation of RNA by orcinol method
3. Determination of purity of DNA
4. Isolation of RNA from plant sample
5. Isolation of DNA from sheep Liver / yeast/ *E.coli*

3. Minor Experiment **10 Marks**

1. Biochemical tests for identification of bacteria.
 - i) Phenylalanine test ii) Malonate test iii) Nitrate reduction test
 - iv) Digestion of casein v) Urease test vi) Digestion of meat
 - vii) H₂S production viii) Starch hydrolysis ix) Decarboxylase test
2. Carbohydrate catabolism by micro-organisms through oxidation and fermentation of glucose.
3. Fermentation of carbohydrates.
4. Isolation of sulphate reducers.
5. Isolation of *Thiobacillus ferrooxidans*
6. Setting of Winogradsky column
7. Isolation and enumeration of nitrifiers

4 Minor Experiment **10 Marks**

1. Problems on DNA characteristics
2. Problems related to DNA characteristics, Transcription, Genetic code, Translation and Gene regulation

5. Spotters Identification (4 Nos) **20 Marks**

1. Cultivation of anaerobic bacteria - Shake culture technique
2. Cultivation of anaerobic bacteria - Pyrogalllic acid
3. Cultivation of anaerobic bacteria - Candle jar method
4. Cultivation of anaerobic bacteria - Liquid paraffin method
5. Cultivation of anaerobic bacteria - Gaspak jar method
6. Photosynthetic bacteria
7. Phenylalanine test
8. Nitrate reduction test
9. Digestion of casein
10. Digestion of meat
11. H₂S production
12. Starch hydrolysis
13. Decarboxylase test

14. Fermentation of carbohydrates.
15. Winogradsky column
16. Bacteria growth curve
17. Plasmid DNA
18. Denitrification and evolution of N₂
19. ATPase
20. Structure of lac operon
21. Semiconservative model of DNA replication
22. Rolling circle replication
23. Nucleosomes
24. Prokaryotic chromosomes
25. Action of topoisomerases
26. t RNA
27. RNA splicing & spliceosome
28. DNA damages

6. Record

10 Marks

Semester – II
Practical Paper – II
MBP 206: ADVANCED IMMUNOLOGY AND BIOPHYSICAL TECHNIQUES & INSTRUMENTATION

1. Typing of human blood groups.
2. Differential staining of WBC by Leishman stain
3. Enumeration of RBC and WBC
4. Estimation of haemoglobin count in blood
5. Widal tests: i) Slide agglutination ii) Tube agglutination methods
6. VDRL test (Venereal disease research laboratory)
7. Hepatitis-B Surface antigen test.
8. HCG test (Agglutination inhibition test)
9. ELISA test.
10. Tridot test
11. Detection of rheumatoid factor
12. Spot test for infections of Mononucleosis
13. RAPITEX CRP Test: i) Qualitative CRP ii) Quantitative CRP
14. Febrile Antigen tube test
15. ASO Test- Anti-streptolysin 'O" test
16. Immuno diffusion test: i) Single radial immuno diffusion ii) Double immuno diffusion
17. Isolation of lymphocytes
18. Rocket immuno electrophoresis
19. Tube flocculation test
20. Determination of P_k value of amino acid
21. Determination of y_{max} of a given solution
22. Separation of Carbohydrates by Paper Chromatography
23. Separation of Amino acids by Paper Chromatography
24. Separation of Lipids by Thin Layer Chromatography
25. Demonstration Column Chromatography
26. Demonstration HPLC and GC
27. Verification of Lambert-Beers Law by UV-VIS Spectrophotometer, scanning
28. Separation of Proteins by Electrophoresis
29. Ultraviolet spectroscopy of Proteins
30. Membrane separation -Dialysis

FACULTY OF SCIENCE
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Practical Examination
MBP 206: ADVANCED IMMUNOLOGY & BIOPHYSICAL TECHNIQUES &
INSTRUMENTATION
Semester - II Question Bank Paper – II

Time: 4 Hrs

Max. Marks: 100

1. Major Experiment

25 Marks

1. Differential staining of WBC by Leishman stain
2. Enumeration of RBC and WBC
3. Estimation of haemoglobin content in blood
4. HCG test (Agglutination inhibition test)
5. Detection of rheumatoid factor
6. RAPITEX CRP Test: i) Qualitative CRP ii) Quantitative CRP
7. Febrile Antigen tube test
8. ASO Test- Anti streptolysin 'O" test
9. Isolation of lymphocytes
10. Rocket immuno electrophoresis.

2. Major Experiment - (To be conducted on instruments)

25 Marks

1. Determination of P_k value of amino acid
2. Determination of y_{max} of a given solution
3. Separation of carbohydrates by paper chromatography
4. Separation of amino acids by paper chromatography
5. Separation of lipids by thin layer chromatography
6. Separation of proteins by electrophoresis
7. Ultraviolet spectroscopy of proteins

3. Minor Experiment

10 Marks

1. Typing of human blood groups.
2. Widal tests - Slide agglutination
3. Widal tests - Tube agglutination methods
4. VDRL test (Venereal disease research laboratory)
5. Hepatitis-B surface antigen test.
6. ELISA test (Direct and sandwich)
7. Tridot test
8. Spot test for infections of Mononucleosis
9. Immuno diffusion test -Single radial immune-diffusion
10. Immuno diffusion test - Double immuno-diffusion
11. Tube flocculation test

4. Minor Experiment

10 Marks

Comment on principle and applications of two instruments

1. Paper chromatography
2. Thin layer chromatography
3. Column chromatography
4. HPLC
5. GLC
6. Gel filtration
7. Ion exchange chromatography
8. Affinity chromatography.
9. pH meter
10. Spectrophotometer

11. Colorimeter
12. Centrifuge
13. Electrophoretic unit
14. Southern blotting
15. Western blotting
16. Northern blotting

5. Spotters Identification (4 Nos)

20 Marks

1. Immuno electrophoresis
2. Lymph node
3. Spleen
4. Thymus gland
5. Structure of IgG, IgM, IgA, IgE
6. Monoclonal antibodies
7. Immunotoxins
8. ELISA plate
9. Immuno precipitation
10. Flow cytometry
11. Immunofluorescence
12. RIA
13. Hypersensitive reactions Type-I,II,II,IV
14. Severe combined Immunodeficiency
15. Grave's disease
16. Autoimmune diseases - SLE
17. Myasthonia gravis disease
18. Graft acceptance rejection in transplantation
19. Tissue typing methods
20. Tumor
21. Recombinant antibodies
22. Animal inoculation
23. Buffers
24. Circular Paper Chromatography
25. Ascending Paper Chromatography
26. Descending Paper Chromatography
- 27 Thin Layer Chromatography
28. GLC
29. Gel filtration
30. Column Chromatography
31. HPLC
32. Ion exchange chromatography
33. Affinity chromatography.
34. Electrophoretic Unit
- 35 Agarose vertical gels with bands
36. Agarose horizontal gels with bands
37. pH meter
38. Spectrophotometer
39. Colorimeter
40. Centrifuge
41. Southern blotting
42. Western blotting
43. Photographs and contributions of Nobel laureates in immunology

6. Record

10 Marks

Semester-III
Paper-I
MBT 301: MICROBIAL GENETICS & GENETIC ENGINEERING

Unit- I

- a. Genetic recombination in bacteria: Conjugation (including sexduction), Transformation and transduction; Models of homologous recombination - The Holliday model and Double strand break repair model. Site specific recombination.
- b. Gene mapping in prokaryotes: Deletion mapping, complementation, intragenic complementation, heteroduplex mapping, DNA foot printing, Chromosome walking and jumping.
- c. Plasmids: Types and Characteristics of plasmids, F plasmids, R-plasmids, Colicinogenic plasmids, Ti-plasmid and other plasmids, broad host range plasmids.
- d. Transposable elements: Types of Bacterial transposons, mechanism and types of transposition. Genetic phenomena mediated by transposons, transposons as genetic tools.

Unit - II

- a. Mutations: Types of mutagens (physical, chemical and environmental), mutagenesis, types of mutations; Molecular basis of mutations-frameshift mutations, transitions, transversions.
- b. Site-directed mutagenesis and its significance.
- c. Mutation screening in microorganisms: Evaluation of mutagens using microbial systems, Ames test, Replica Plating method, Antibiotic enrichment test and Chromogenic substrate test.
- d. Molecular methods for detection of mutations: Genotyping of Bacteria and Viruses, DNA sequencing, AFLP, RFLP and RAPD methods.

Unit - III

- a. Recombinant DNA technology: DNA manipulating enzymes, Restriction endonucleases - specificity, sticky ends and blunt ends.
- b. Cloning vectors: Plasmids, phasmids, phagemids, cosmids, YAC and BAC vectors and their advantages and disadvantages. Ligation, optimizing ligation conditions- linkers, adapters, homopolymer tailing.
- c. Selection of transformants: Insertion inactivation and Blue and white selection. Identification of cloned genes-colony hybridization.
- d. DNA libraries: Construction and screening of genomic libraries; isolation of mRNA, cDNA synthesis and cDNA libraries.

Unit - IV

- a. Polymerase chain reaction (PCR) technology: Theoretical aspects of PCR- PCR cycle, thermostable DNA polymerases, primers and their importance, optimizing the conditions for PCR, factors limiting PCR efficiency.
- b. Different versions of PCR: AP-PCR, Multiplex PCR, Broad range PCR, Inverse PCR, Nested PCR, Real time PCR and their applications; Applications of PCR technology- Forensic, clinical diagnosis, detection of pathogens in food, water; PCR in molecular evolution.
- c. Applications of rDNA technology in medicine and industry: Production of heterologous protein products, role of expression vectors, production of insulin, human growth hormone and hepatitis vaccine.
- d. Gene therapy: Inherited disorders, detection of gene defects, strategies for gene therapy- *in vivo* and *ex vivo* therapies. Gene delivery strategies: viral vectors and liposomes their advantages and disadvantages. Future prospects of gene therapy.

Recommended Books

1. Brown, T.A. 1999 Gene Cloning. 3rd edition. Chapman and Hall Publications, USA.
2. Burrell, M.M. 1993. Enzymes of Molecular Biology, Humana Press.
3. Chirikjian, J.G. 1995 Biotechnology – Theory and Techniques, Vol. II, Jones and Bartlett Publishers.
4. Gerhardt, P. Murray, R.G., Wood, W.A., and Kreig, N.R. 1994 Methods for
5. 5 General and Molecular Bacteriology, ASM Press, Washington D.C.
6. Glick, B.R. and Pasternak, J.J. 1998 Molecular Biotechnology – Principles and Applications of
7. Recombinant DNA, ASM Press, Washington D.C.
8. Lewin, B. 2008 Genes IX. Oxford University Press, Oxford.
9. Murray Moo1992 Plant Biotechnology. Young, Pergamon Press.
10. Ratledge, C. and Kristiansen, B. 2001 Basic Biotechnology, II Edition, Cambridge University Press.
11. Winnacker, E.L. 1987 From genes to Clones: Introduction to Gene technology. V C H Publications,
12. Federal Republic of Germany.
13. Antony, J.F., Griffiths, Gilbert, W.M., Lewontin, R.C. and Miller, J.H. 2002 Modern genetic analysis,
14. Integrating Genes and Genomes, 2nd edition, WH Freeman and Company, New York.
15. Blackburn, G.M. and Gait, M.J. 1996 Nucleic acids in chemistry and biology. Oxford University Press.
16. Molecular Biology of cell. Albert *et al.*, 4th Edition Garland Publishing Inc.
17. George M. Malacinski, David Freifelder. 1998 Essentials of Molecular Biology. Jones and Bartlett
18. Publishers.
19. Maloy, S.R., Cronan, J.R. Freifelder, D. 1994 Microbial Genetics, Jones and Bartlett Publishers.
20. Macinski, G.M. and Freifelder, D. 1998 Essentials of Molecular Biology, 3rd Edition, John and Bartlett
21. Publishers.
22. Sir John Kendrew 1994 The Encyclopedia of Molecular Biology. Blackwell Science Ltd
23. Watson, J.D., Hopkins, N.H., Roberts, J.W., Steitz, J.A. and Weiner, A.M. 1998 Molecular Biology of the
24. Gene, 4th edition, Benjamin/Cummings publishing company.
25. Freifelder, D. 1997 Essentials of Molecular Biology. Narosa Publishing House, New Delhi.
26. Freifelder, D. 1990 Microbial Genetics. Narosa Publishing House, New Delhi.
27. Snyder, L. and Champness, W. 1997 Molecular Genetics of Bacteria. ASM press, USA.
28. Maloy, S.R., Cronan, J.E. and Freifelder, D. 1994 Microbial Genetics, Jones and Bartlett Publishers,
29. London.
30. Turner, P.C., Mclennan, A.G., Bates, A.D. and White, M.R.H. 1998 Instant Notes in Molecular Biology,
31. Viva Books Pvt., Ltd., New Delhi.
32. Twynan, R.M. 2003 Advanced Molecular Biology. Viva books Pvt. Ltd. New Delhi.
33. Old, R.W. and Primrose, S.B. 1994 Principles of Gene Manipulation, Blackwell Science Publication.

Semester - III Paper-II

MBT 302: BIOINFORMATICS & COMPUTATIONAL METHODS

Unit – I

- a. Bioinformatics: definition, concept, scope, relevance of bioinformatics, development of bioinformatics, applications of bioinformatics. Operating systems (Linux) and programming languages (Perl, CORBA) in bioinformatics.
- b. Databases: Gene banks, objectives, types of databases- flat files, relational databases, objective oriented databases, hypertext databases, web interfaces; Resource databases- Generalized (DNA, protein) and specialized databases.
- c. Search tools: Data mining, BLAST and FASTA.
- d. Sequence analysis of biological data: terminology, methods for alignment- pairwise & multiple sequence alignments, algorithm for alignment of sequencing fragments

Unit – II

- a. Phylogenetic analysis: Concept of phylogenetic trees, phylogenetic trees and multiple alignment methods - distance matrix, character based evaluation of methods, evaluation of phylogenies, steps in constructing alignments and phylogenies, working with phylogeny trees- with suitable software-EMBOSS
- b. Gene prediction: Approaches and methods, tools- GRAIL, GenLang, BCM GeneFinder, Procrutes, GeneParser. Prediction of protein structure- Methods for structure prediction for known and unknown folds, prediction of protein function.

- c. Genomics: Gene mapping, sequence assembly and gene expression, DNA microarrays, microarray design and data analysis.
- d. Proteomics: Definition, proteome analysis; tools for proteome analysis, protein-protein interactions; metabolic and genetic networks, concept of E- cell.

Unit – III

- a. Biostatistics: Definition, scope, applications in biology, terminology; sampling techniques-random and non-random methods.
- b. Measures of central tendencies: Mean, mode, median, standard error and standard deviation.
- c. Probability: Concepts, terminology, kinds of probabilities, theorems of probability, normal, binomial and poisson distribution.
- d. Chi Square test: Characteristics of chi-square test, degrees of freedom, test of goodness of fit, null hypothesis.

Unit – IV

- a. Analysis of variance (ANOVA): Methods of ANOVA, one way and two way classifications, F-test, steps involved in ANOVA, importance of ANOVA.
- b. Correlation: Definition, methods of studying the correlation, types of correlations-scatter diagram, Karl Pearson's efficient of correlation and rank correlation method.
- c. Regression: Definition, types of regression analysis, regression equation, methods of studying regression, graphic and algebraic methods, importance of regression.
- d. Importance of statistical software in data analysis.

Recommended Books

1. Andreas D. Baxevanis, B.F. Francis Ouellete. 2004 Bioinformatics A practical guide to the analysis of genes and proteins,
2. Attwood, T.K. and D.J Parry-Smith. Introduction to Bioinformatics
3. Bishop, M. J. and C.J. Rawlings Nucleic acid and protein sequence analysis-A practical approach
4. Blinks, C.K 1967 Statistics in biology vol 1 Mc Graw Hill, New York
5. Brown, T.A Genomes John Wiley & Sons Asia Pte. Ltd. 1999
6. Campbell RC 1974 Statistics for Biologists Cambridge university press
7. Chritine Orengo, David Jones, Janet Thornton. Bioinformatics: genes, proteins and computers
8. Cynthia and Perk Jambeck Bioinformatics computer skills, Wiley
9. Dan E. Krane, Michael Raymer. 2003 Fundamental Concepts of bioinformatics,
10. David Mount. 2003 Bioinformatics sequence and genome analysis
11. Hewitt.W 1977 Microbiological assay Academic press, New York
12. Higgins, W. Taylor. Bioinformatics: Sequences, structure and databanks- A practical approach,
13. Jean-Michel claverie, Cedric Notredme Bioinformatics A Beginner's Guide, Wliiey Publication
14. Jonathan Pevsner. 2004 Bioinformatics and Functional Genomics
15. Stephen Misener and Stephen A. Krawetz. Bioinformatics methods and protocols
16. Wardlaw, AC 1985 Practical statistics for experimental Biologists.

Semester - III

Paper - III

MBT 303 (A): BIOPROCESS TECHNOLOGY

Unit – I

- a. An overview of fermentation technology, range of fermentation processes, primary and secondary metabolites, components of fermentation process.
- b. Industrial microorganisms: isolation, preservation, screening and strain improvement and maintenance.
- c. Formulation of industrial media: Medium requirements for fermentation processes, carbon, nitrogen, mineral sources, buffers, antifoam agents, medium optimization.
- d. Stoichiometry of cell growth and product formation, Sterilization of media and fermenters, scale – up process and starter culture technology

Unit – II

- a. Basic design of a microbial fermentor, types of fermentation vessels. aseptic operation, containment,
- b. Body construction (stirrer glands, bearing, valves, steam traps) baffles, spargers and impellers.
- c. Types of fermentations: batch, continuous, fed-batch, solid state, sub-merged.
- d. Aerobic and anaerobic, dual and multiple fermentations, their advantages and disadvantages.

Unit – III

- a. Importance of downstream processing in industrial fermentation processes. Problems and requirements of bio product recovery and purification.
- b. Physico- chemical basis of bio separation processes.
- c. Fermentation economics - Market potential, some effects of maintenance legislation on production of antibiotics and recombinant proteins, plant and equipment.
- d. Continuous culture, recovery costs, water usage and recycling and effluent treatment.

Unit – IV

A brief out lines of processes for the production of the following commercially important products:

- a) Primary metabolites
 - i. Organic acids : Citric acid, Lactic acid,
 - ii. Amino acids : Glutamic acid, L-lysine,
 - iii. Solvents : Acetone, Ethyl alcohol
- b) Secondary metabolites
 - i. Antibiotics : Streptomycin, Penicillin
 - ii. Vitamins : B₁₂, Riboflavin,
 - iii. Biofuels : Hydrogen, Methane

Recommended Books

1. Ali Cinar, Satish J. Parulekar, Cenk Undey, Birol Gulnur 2003 Batch Fermentation: Modeling, Monitoring, and Control Marcel Dekker Inc
2. Berry, D.R. (Ed) 1998 Physiology of Industrial fungi BSP, Oxford University.
3. Crueger & Crueger Biotechnology: A Text Book of Industrial microbiology 2nd edition
4. Dellweg .Biotechnology Vol III.
5. Demain, A.L Biology of Industrial Microorganisms
6. Diliello Methods in Food and Dairy Microbiology
7. Harold B. Reisman 1988 Economic Analysis of Fermentation Processes CRC Pr I Llc
8. Henry,C.Vogel and L. Celeste Todaro 2005 Fermented and Biochemical Engineering Hand Book 2ed Standard Publishers Distribution New Delhi
9. Coeplor, S.H. and D.Perhman Encyclopedia of Industrial microbiology Vol. I & II
10. Patel, A.H. Industrial microbiology
11. Peppler & Pearlman .Microbial Technology Vol I & Vol II .
12. Prescott & Dunn, Industrial microbiology,
13. Prescott & Dunn's Fundamentals of Applied Microbiology (2nd edition)
14. Rao. D.J. 2005 Intriducion to Biochemical Engineering McGraw-Hill
15. Reed, G. Industrial Microbiology, CBS Publishers

Semester – III

Paper - III

MBT 303 (B): CLINICAL MICROBIOLOGY

UNIT-I

- a. Introduction to laboratory organization, lab safety and instrumentation.
- b. Methods of collection of clinical specimen for Microbiological investigation: Sputum- Petroff's method of concentration. Urine, Swabs, Stool, Blood, CSF and Aspirates.
- c. Processing of clinical specimen: Preparation of direct smear and staining, Different techniques of inoculation for isolation of bacteria.
- d. Preparation and inoculation of various media for Bio-chemical reactions.

UNIT-II

- a. Composition, preparation of staining reagents, Different methods of staining: simple staining, Gram's staining, Giemsa's staining, Zeihl Neelson staining, Albert staining, Negative staining, Fluorescent staining.
- b. Culture media: Classification of Media, Composition, preparation and uses: Basal media (peptone water, Nutrient agar, glucose broth), Enriched media (Blood agar, Loeffler's serum slope, chocolate agar), Enrichment media (Selenite F broth, Tetrathionate broth, Alkaline peptone water), Differential media (MacConkey's agar), Indicator & selective media (Lowenstein-Jensen media, Potassium tellurite media, TCBS, Wilson and Blair media).
- c. Media for blood culture: Brain heart infusion broth, Trypticase soya broth, Anaerobic media- Robertson's cooked meat media, Thioglycolate media. Fungal media- Sabouraud's dextrose agar.
- d. Media for Biochemical reactions- Indole, MR, VP, Citrate, Urease, Oxidase, Catalase, Nitrate reduction test, Phenyl alkaline deaminase test.

UNIT-III

- a. Urine Analysis: Collection of samples, Types of samples, Physical examination: Colour, Appearance, Quantity, Odour, Specific gravity, Albumin, pH.
- b. Chemical examination: Sugar, Ketone bodies, Albumin, Bile salts, Bile pigments, Blood
- c. Microscopic examination- Centrifuging, crystals, RBC and casts, Wbc and casts, Epithelial cells and casts, Hyaline casts, Granular casts.
- d. Sputum analysis: Physical examination, making a smear, Staining, Mounting, Microscopic examination.

UNIT-IV

- a. Methods of blood collection: Venous puncture, Finger puncture, Vacutainer methods, Materials required, Procedure, Precautions, Uses of Sample & advantage of each method.
- b. Preparation of antiagulants: Double oxalate, Sodium citrate, EDTA, Heparine.
- c. Platelet count, Reticulocyte count, Haemoglobin estimation.
- d. Estimation of PCV- Macro & Micro methods, Procedure of filling tube, centrifuge and reading, Estimation of Erythrocyte Indices: Calculation and importance MCV, MCH, MCHC, RDW, color index.

Recommended Books

1. Parasitology- K.D.Chatterjee
2. Practical Haematology- 9th edition Dacie & Lewis
3. Haematology- 6th edition- Williams
4. Wintrobe clinical haematology Vol-II- 10th edition
5. Lynch's medical lab- Technology Latest edition
6. Medical Laboratory Technology by Sood 5th edition, Jaypee Brothers 1999
7. Clinical Haematology in Medical Practice- G.C.Degruchy- 5th edition.

Semester - III

Paper- IV

MBT 304 (A): AGRICULTURAL MICROBIOLOGY

Unit - I

- a. Natural and man engineered ecosystems - suitability of soil for agriculture, soil chemistry, humus formation, soil fertility, micro/macro nutrients, frequency/density and abundance of soil microbes, biological significance of soil enzymes.
- b. Global nitrogen cycle – microbiology and ecological importance of ammonification, nitrification and denitrification – organisms that fix atmospheric nitrogen (free living, aerobic, symbiotic, endophytic bacteria).

- c. Biology of nitrogen fixation – Physiology of legume root nodule, leghaemoglobin synthesis, biochemistry and genetics of symbiotic and asymbiotic nitrogen fixation, action of nitrogenase and hydrogenase.
- d. Rhizosphere – Nature, extent, influence of root exudates on microflora, plant growth promoting rhizobacteria (PGPR) and siderophore production, nature and ecological significance of ectotrophic and endotrophic mycorrhizal associations, role of microbes in transformation of phosphorus, sulphur and iron.

Unit - II

- a. Principles of plant disease resistance, entry and establishment of pathogens in plants, host-parasite interaction, role of enzymes and toxins in pathogenesis.
- b. Protection and defense, mechanism of disease resistance (performed and induced defense, local signals), programmed cell death, induced structural barriers, phytoalexins.
- c. Biochemical basis of disease resistance – Systemic acquired resistance (SAR), Local acquired resistance (LAR) and Pathogenesis related proteins (PR-proteins) - chitinases and glucanases.
- d. Transgenic Resistance - horizontal and vertical resistance, classification and functions of resistance genes, transformation for disease resistance, Bt genes and resistance to insects.

Unit - III

- a. Plant disease triangle, disease forecasting, reproduction, inoculum, virulence, dissemination.
- b. Symptoms, disease cycle and management of the following plant diseases: Fungal diseases – late blight of potato, downy mildew of grapes, loose smut of wheat, smut of bajra, covered smut of barley, blast disease of paddy, red rot of sugarcane.
- c. Bacterial diseases – bacterial blight of paddy, angular leaf spot of cotton, common scab of potato.
- d. Viral diseases – tobacco mosaic, leaf curl of tomato, yellow vein mosaic of bhindi.

Unit - IV

- a. Cultural methods, agronomic practices (crop rotation, field and crop sanitation), chemical control (fungicides, fumigants, inorganic copper/sulphur compounds, dithiocarbamates)
- b. Organic agriculture and disease control – Biofertilizers – development and the concept, *Rhizobium*, *Bradyrhizobium*, *Azotobacter*, *Azospirillum*, *Acetobacter*, *Frankia*, algal fertilizers, mass cultivation techniques, quality control of biofertilizers, field performance of biofertilizers, problems and prospects.
- c. Microbial pesticides – development and significance, source organisms, Bacteria – *Bacillus thuringiensis*, Bt based commercial products, other bacilli producing pesticides, Fungi – *Beauveria bassiana*, *Metarhizium anisopliae*, *Trichoderma viride*, Viruses - Baculo virus for insect pest control (NPV – Nuclear Polyhedrosis Virus).
- d. Post harvest diseases and their control – microbial spoilage of fruits and vegetables, stored grains/seeds, mode of infection and factors influencing post-harvest diseases, strategies for post-harvest disease control through fungicides, irradiation, fumigation and vapor heat treatment.

Recommended Books

1. Agrio, G.N. Plant pathology
2. Alexander, M Soil Microbiology
3. Benjamin Cunnings, Merio pank. California 1987 Microbial ecology, fundamentals an application
4. Bilgrami, K.S. and H.C. Dube Modern Plant pathology
5. Biofertilizedrs by N.S. Subba Rao
6. Lynch J.M. Soil Biotechnology
7. Lynch Poole Microbial ecology : A conceptual approach
8. Mehrotra, R.S. Plant Pathology
9. Microbial ecology: Principles, methods & applications & Biological nitrogen fixation.
10. R.S. Singh An introduction to principles of plant pathology
11. Rangaswami, G. and A. Mahadevan Diseases of crop plants

12. Rangaswamy, G and. Bhagyaraj D.J .Agricultural Microbiology by
13. Richard, B.N. An introduction to soil ecosystem
14. Singh, R.S. Plant diseases R
15. Stolop H. Microbial ecology : Organisms, habitats, Activities
16. Subba Rao N. S Advances in Agriculture Microbiology by
17. Subba Rao, N.S. Soil microorganisms and plant growth
18. Tarr, S.A.J. Principles of plant pathology
19. Vander Plank Plant disease resistance
20. Vidyasekaran Molecular plant pathology

Semester – III
Paper – IV
MBT 304 (B): DAIRY MICROBIOLOGY

Unit – I

- a. Composition and nutritive value of Milk.
- b. Types of Milk (skimmed, toned and homogenized). Concept of clean milk.
- c. Factors affecting quality and quantity of milk.
- d. Physico-chemical properties of milk.

Unit – II

- a. Microflora of milk and milk products, sources of contamination of milk. Types of microorganisms present in milk.
- b. Biochemical activities during microbial spoilage of milk. Milk borne diseases.
- c. Milk preservation methods: Methods of Pasteurization – LTH, HTST, UHT. Storage specific pasteurization.
- d. Phosphatase test and its significance. Dye reduction test (using methylene blue and resazurin). Total bacterial count. Brucella ring test and tests of mastitis.

Unit – III

- a. Types of fermented dairy products. Production of starter cultures and Methods of preparation.
- b. Fermented dairy products: General principles and production of cultured buttermilk, Acidophilus milk, Bifidus milk, Bulgarian sour milk, yoghurt, Kefir, Koumiss and ice creams.
- c. Cheese-principles of cheese making, Cheddar cheese, Swiss cheese, surface ripened cheese, mould ripened chesses. Spoilage and defects in cheese.
- d. Production and usage of microbial enzymes for dairy processing.

Unit – IV

- a. Probiotics and prebiotics - types of microorganisms used as probiotics.
- b. Fermented dairy products and their role in controlling food borne diseases
- c. Therapeutic significance and their health properties. Mode of action of lactic acid bacteria (LAB) on enteric pathogens. Fermented dairy products and their role in controlling gastrointestinal tract disorders.
- d. Food hygiene and control-food sanitation. Food control agencies and its regulations.

Recommended Books

1. Food processing Biotechnological application (2000) by S.S.Marwaha & K.Arora, Asiatech Publishers INC, New Delhi.
2. Food science, Fifth Edition, Norman N. Potter 1996, CBS publishers and distributors.
3. The technology of food preservation, Fourth Edition, Norman W. Desrosier (BI Publisher and Distributors, Delhi, 1987)
4. Food Microbiology - Adams & Moss
5. Dairy Microbiology – Robison
6. Outlines of Dairy technology – Sukumar De
7. Food Science (Vth edn) Norman N. Potter, Joseph N. Hotchkiss.

8. The Technology of Food Preservation: 4th Edi. Norman N. Potter (1987) CBS Publi.
9. Milk and Milk Products: 4th Edi. Clasen Henry. TMH Publications.
10. Food Processing: Biotechnological Applications (2000). S.S.Marwaha and Arora. Asiatech publications, New Delhi.
11. Food Microbiology: Frazier.
12. Food Microbiology: James De and De.
13. Dairy Technology: Sukumar De.
14. Food Science: 5th Edi, Norman N. Potter (1996). CBS Publications and distributors.

Practical Paper – I

MBP 305: MICROBIAL GENETICS & GENETIC ENGINEERING & BIOINFORMATICS & COMPUTATIONAL METHODS

1. Isolation of auxotrophic mutants by Replica plate technique
2. Mutagenesis and UV survival curve
3. Isolation of petite mutants
4. Restriction analysis of DNA and agarose gel electrophoresis
5. Diauxic growth experiment
6. Preparation of competent cells
7. Transformation- selection of recombinants-Blue and white selection(X-gal method)
8. Amplification of DNA by PCR
9. Problems related to
 - (a) Mutation (b) Recombination(Conjugation, transformation, transduction), (c) Gene mapping (d) Restriction mapping (e) Primer design and PCR amplifications (f) DNA libraries.
10. Aligning sequences using Clustal-X
11. Sequence data retrieval in FASTA format from NCBI database.
12. Similarity search in BLAST for protein or nucleotide sequence.
13. Prediction of secondary structure of protein
14. Viewing the Protein Data Box (PDB) files using Rasmol software.
15. Conversion of raw sequences into different sequence format by using Read Seq Tool.
16. Classification of data, computation of mean, mode, median and standard deviation
17. Co-efficient of variation, skewness and Kurtosis
18. Correlation and regression coefficients
19. Fitting of straight line, parabola, power curve, exponential curve.
20. Chi-square test
21. Normal distribution-co ordinates method
22. ANOVA- one way classified data- two way classified data
23. Completely Randomized Design (CRD)
24. Randomized Block Design (RBD)
25. Latin Sequence design (LSD)
26. Application of t-test and F-test

**FACULTY OF SCIENCE
M.Sc. MICROBIOLOGY
Practical Examination
Semester - III Question Bank Paper – I**

MBP 305: MICROBIAL GENETICS & GENETIC ENGINEERING & BIOINFORMATICS & COMPUTATIONAL METHODS

Time: 4 Hrs

Max. Marks: 100

1. Major Experiment

25 Marks

1. Isolation of auxotrophic mutants by replica plate technique.
2. Mutagenesis and plotting of U.V survival curve
3. Isolation of petite mutants of Yeast
4. Restriction digestion of DNA and analysis of fragments by electrophoresis
5. Preparation of competent cells

6. Transformation – selection of recombinants – Blue and white selection (X-gal method)
7. Amplification of DNA fragments by PCR and visualisation of amplicons
8. Southern blotting technique.

2. Major Experiment **25 Marks**

1. Aligning sequences using Clustal-X
2. Sequence data retrieval in FASTA format from NCBI database
3. Similarity search in BLAST for protein or nucleotide sequence
4. Prediction of secondary structure of protein
5. ANOVA-one way and two- way classified data.
6. Problems related to regression and correlation.

3. Minor Experiment **10 Marks**

Problems related to

1. Mutation studies
2. Recombination (Conjugation, transformation and transduction)
3. Gene mapping
4. Restriction digestion
5. Primer design and PCR amplifications
6. DNA libraries

4. Minor Experiment **10 Marks**

1. Computation of mean, mode, median, standard deviation and standard errors.
2. Problems related to theorems of probability
3. Problems related to Chi-square test.

5. Spotters Identification (4 Nos) **20 Marks**

1. Restriction digestion-sticky ends and blunt ends.
2. RNA polymerase activity
3. pBR 322
4. pUC 18
5. Ti plasmid
6. Replica plating
7. DNA ladders
8. PCR unit
9. Electrophoresis unit
10. Gene gun
11. Identification of recombinants (Blue and white colonies)
12. Ames test
13. Transgenic plants (Tobacco luciferase)
14. Transgenic animals (Dolly)
15. Protocols for cDNA and genomic libraries
16. Carcinogenic chemicals
17. Colon cancer
18. Retinoblastoma cancer
19. Recombination-Holliday model
20. Transposons (T5, T10)
21. DNA damage-molecular models
22. Gene therapy-*in vivo*, *ex vivo* models

6. Record **10 Marks**

Semester- III
Practical Paper- II
MBP 306 (A): BIOPROCESS TECHNOLOGY

1. The use of Logarithms in Microbial growth study, in fermentation process.
2. Determination of the midpoint of the Logarithmic phase of microbial growth in fermentation process.
3. Harvesting the microbial cells and determination of the yield of Fermentation products.
4. Manometric study in Fermentation process.
5. Isolation and identification of secondary metabolites in the fermentation process.
6. Design and construction of microbial fermentor.
7. Screening of microorganisms through war cup method in strain improvement.
8. Production and estimation of streptomycin.
9. Production and estimation of Lactic acid.
10. Production and estimation of Ethyl alcohol.
11. Production and estimation of Penicillin.
12. Production and estimation of Indole Acetic Acid (IAA).
13. Estimation of Cynacobalamine(Vitamin B12).

Spotters:

- | | |
|-------------------------|--------------------------|
| 1. Design of fermenter | 8. Baffles |
| 2. Seed Flask | 9. impellers |
| 3. Seed fermenter | 10. Bread |
| 4. Production fermenter | 11. Monometric fermenter |
| 5. Air sparger | 12. Strain improvement |
| 6. Foam breaker | 13. Immobilized beads |
| 7. Stirrer gland | |

Semester- III
Practical Paper- II
MBP 306 (A): CLINICAL MICROBIOLOGY

1. Collection of clinical samples like blood, Urine, Stool, Sputum, Swabs.
2. AFB Staining for Sputum.
3. Identification of organisms by culturing on selective media- *Staphylococcus*, *E.coli*, *Salmonella*, *Shigella*.
4. Antibiotic Sensitivity tests.
5. Wet mount preparation of feacal sample for Ova Cysts of parasites.
6. Collection of Specimen for fungal examination like Skin scrapings
7. Fungal examination by wet mount preparation
8. Serological test- WIDAL, VDRL, ELISA.
9. Routine examination of Urine for Microscopy.
10. Haemocytometry, Procedures for cell counts, Red blood cells, Leucocytes & Platelet counts.

Spotters

- | | |
|---------------------------|---------------------------|
| 1. Streak plate technique | 6. Zeihl Nielson staining |
| 2. TSIA slant | 7. Sabourauds agar medium |
| 3. Macconkeys agar plate | 8. Ketone bodies |
| 4. Urease test | 9. Hyaline casts |
| 5. Loeffler serum slop | 10. EDTA anticoagulate |

Semester- III

Practical Paper- II

MBP 306 (B): AGRICULTURAL MICROBIOLOGY

1. Solubilization of rock phosphate by microorganisms
2. Estimation of organic matter in agricultural soils to assess the soil fertility
3. Estimation of cell wall degrading enzymes : cellulases (exo- and endo glucanases), polymethyl esterase, poly galacturonase, pectic lyase in host-pathogen interactions
4. Estimation of accumulated soil enzymes : catalase/peroxidase, phosphatase, urease,
5. Isolation and identification of cyanobacteria used as biofertilizers- *Nostoc*, *Anabaena*, *Scytonema*
6. Isolation of *Rhizobium* from root nodules
7. Classification and symptomatology of plant diseases covered in theory (unit III)
8. Determination of Disease Tolerance Index (DTI) in crop plants
9. Biochemical changes in healthy and diseased crop plants: carbohydrates, proteins, amino acids, chlorophyll
10. Quantification of phytoalexins in healthy and diseased crop plants
11. Analysis of PR proteins in healthy and diseased plants through electrophoresis
12. Enumeration of Rhizosphere microflora and comparison with normal soil microflora
13. Enumeration of ammonifiers, nitrifiers and denitrifiers in soil samples
14. Assay of fungicides by humid chamber technique and calculation of LD50 value
15. Section cutting of infected plant parts.

Spotters:

- | | |
|---------------------------------|----------------------------------|
| 1. Downy mildew of peas | 15. Bacterial blight of paddy |
| 2. Downy mildew of bajra | 16. Citrus canker |
| 3. White rust of crucifers | 17. Angular leaf spot of cotton |
| 4. Powdery mildew of cucurbits | 18. Stalk rot of maize |
| 5. Rust of beans | 19. Sesamum phylloidy |
| 6. Rust of pea | 20. Tobacco mosaic virus |
| 7. Rust of ground nut | 21. Yellow vein mosaic of bhendi |
| 8. Whip smut of sugarcane | 22. <i>Nostoc</i> , |
| 9. Wilt of pigeon pea | 23. <i>Anabaena</i> , |
| 10. Wilt of cotton | 24. <i>Scytonema</i> |
| 11. Root rot of cotton | 25. <i>Rhizobium</i> |
| 12. Stem rot of rice | 26. Ammonifiers, |
| 13. Brown spot diseases of rice | 27. Nitrifiers |
| 14. Blast diseases of rice | 28. Denitrifiers |

Semester- III

Practical Paper- II

MBP 306 (B): DAIRY MICROBIOLOGY

1. Chemical examination of milk - pH, fat, protein, sugar, and ash
2. Physical examination of milk - specific gravity and Different solids
3. Detection of number of bacteria in milk by standard plate count (SPC)
4. Determination of quality of milk sample by methylene blue reductase test (MBRT)
5. Determination of antibacterial activity of lactic acid bacteria using agar well diffusion method
6. Examination of microbial load in ice creams
7. Isolation of microbes from yoghurt or curd
8. Isolation of lactic acid bacteria (LAB) from curd or milk sample
9. Isolation and identification of food poisoning bacteria from dairy products
10. Production and estimation of lactic acid by *Lactobacillus* sp. / *Streptococcus* sp.
11. Microbiology of butter and cheese

12. Production of fermented milk by *Lactobacillus acidophilus*

Spotters:

- | | |
|----------------------------------|--------------------------|
| 1. Nutritive values of milk | 7. Curd |
| 2. Skimmed milk | 8. Cheese |
| 3. Homogenous milk | 9. Probiotics |
| 4. Microbial spoilage of milk | 10. Lactic acid bacteria |
| 5. Methylene blue reductase test | 11. Bifidobacterium |
| 6. Butter | |

FACULTY OF SCIENCE
M.Sc. MICROBIOLOGY
Practical Examination
Semester - III Question Bank Paper - II
MBP 306: BIOPROCESS TECHNOLOGY/CLINICAL MICROBIOLOGY
AND
AGRICULTURAL MICROBIOLOGY/DAIRY MICROBIOLOGY

Time: 4 Hrs
100

Max. Marks:

1. Major Experiment	25 Marks
2. Major Experiment	20 Marks
3. Minor Experiment	10 Marks
4. Minor Experiment	10 Marks
5. Spotters Identification (4 Nos)	20 Marks
6. Record	10 Marks

Semester-IV
Paper- I
MBT 401: ENVIRONMENTAL MICROBIOLOGY

Unit - I: Microbial Diversity

- a. Introduction to Microbial Diversity, types of micro-organisms - bacteria, archebacteria, eucarya, interaction between microorganisms, microbial succession.
- b. Extremophiles – Habitat, effect of extreme conditions on cellular components, membrane structure, nucleic acids and proteins, adaptation mechanisms in micro-organisms in diverse environments.
- c. Study of thermophiles, psychrophiles, halophiles, piezophiles, acidophiles, alkalophiles, xerophiles, radiation resistant organisms, methanogens.
- d. Biotechnological applications of extreme proteins from above groups, Geomicrobiology – biofouling, biocorrosion.

Unit - II: Soil Microbiology

- a. Principles and concepts of soil microbiology: soil principles and properties – soil formation, texture, composition, characteristics, density and biomass of microbes in soil, terrestrial carbon cycles, soil fertility.
- b. Decomposition of organic matter – litter chemistry, carbon assimilation and immobilization, dynamics of organic matter, accumulated soil enzymes and their role in soil development.
- c. Bioremediation of polluted soils – Microbes in polluted soils, strategies of their survival, mechanisms of the degradation of pesticides, biohydrometallurgy using recombinant microbes for recovery of precious metals.
- d. Microbial leaching and biomining (copper and uranium) – dump, heap and agitated leaching, chemistry and microbiology of bioleaching, biomining (*ex situ and in situ* – hole to hole leaching), plasmids and genes in biomining.

Unit - III: Water Microbiology

- a. Principles and concept of Water Microbiology: Global water reserves, physical/chemical/biological/microbiological characteristics of water, water consumption cycle, biomonitoring of the aquatic environment, pollution indices, eutrophication.
- b. Waste water treatment through aerobic microorganisms – Biological filters, aeration tanks, activated sludge, biological ponds, irrigation fields.
- c. Waste water treatment through anaerobic microorganisms – septic tanks, imhoff's tank, upflow anaerobic sludge blanket (UASB), anaerobic filters, anaerobic attachment film expanded bed (AAFEB), anaerobic rotating biological contractor.
- d. Pollution control biotechnology – commercial blends of microorganisms and enzymes, immobilized cells and enzymes, biotechnological approaches for recovery of useful products from sewage and industrial wastes (methane).

Unit - IV: Microbiology of Air

- a. Historical introduction – Nomenclature of atmospheric layers, microbes as source and sink of atmospheric pollutants, pollutant transformation by microbes, air borne microbes and their reservoirs, bioaerosols.
- b. Air sampling techniques – slit samples, cascade impactor, hirst trap, anderson's air sampler, vertical cylinder trap, burkard trap. The impingers – proton impinger and pre-impinger.
- c. Air quality in Indian cities – mapping of the hot spots, air quality monitoring and measurement, impact of air-borne microorganisms on living beings, fungal allergy, immediate/delayed type of hypersensitivity, atopic allergy.
- d. Air sanitation – control of air borne pathogens, irradiation, chemical disinfection, dust control. Biotechnological methods for the abatement of environmental bio-pollution.

Recommended Books

- | | |
|--------------------------------|---|
| 1. Alexander M. | Soil Microbiology |
| 2. Anil Prakash (Ed.) | Fungi in Biotechnology |
| 3. Atlas & Batra | Microbial Ecology |
| 4. Benjamin Cunnings | Microbial Ecology |
| 5. Burns R.G & J.H.Slater | Experimental Microbial Ecology - |
| 6. Gabriel Bitton | Wastewater Microbiology |
| 7. Gilbert S. Omen | Environmental Biotechnology |
| 8. Gray T.R.G.&S.T.Williams | Soil Microorganisms |
| 9. Gregory P.H. | The Microbiology of Atmosphere |
| 10. Lautit M.W&C.M.Eds.Keuin | Microbial Ecology Proc. |
| 11. Lynch J.M | The Rhizosphere |
| 12. Lynch J.M and N.J. Poole | Microbial Ecology: A conceptual approach |
| 13. Michael S.Switzerbaury(Ed) | Anaerobic Treatment of Sewage |
| 14. Mishra R.R | Soil Microbiology |
| 15. Odum E.P. | Fundamentals of Ecology |
| 16. Omenn G.S.& M. Alexander | Genetic control of Environmental Pollutants |
| 17. Ralph Mitchell | Environmental Microbiology |
| 18. Ratledge C. | Biochemistry of Microbial degradation |
| 19. Spani J.C. | Biodeterioration of non-aromatic compounds |
| 20. Subba Rao N.S. | Soil Microbiology |
| 21. Thomas D. Brook | Thermophiles |
| 22. Tilak S.T | Environmental Biopollution |
| 23. Williams G.C | Biofilms |

Semester - IV

Paper - II

MBT 402: MEDICAL MICROBIOLOGY

Unit – I

- History of medical microbiology. General attributes and virulence factors of bacterial and viral infections.
- Diagnosis of infectious diseases: Types of specimens, specimen collection, transport and processing of material, culture isolation and identification for microbiological diagnosis.
- Immunodiagnosis: Immunological assays, Serological tests and Immunoblotting.
- Molecular diagnosis: Nucleic acid hybridization techniques, PCR, Transcription Mediated Amplification (TMA), Nucleic acid Sequence Based Amplification (NASBA), Ligase chain reaction.

Unit – II

Morphology, cultural characteristics, antigenic structure, pathogenicity, clinical symptoms, laboratory diagnosis, prevention-control and treatment of diseases caused by the following organisms

- Air borne infections: *Streptococci*, *Corynebacterium diphtheria*, *M. tuberculosis* and *N. meningitis*
- Water born infections: *E. coli*, *Salmonella*, *Shigella*
- Wound infections: *Clostridium tetani*, *Staphylococci*, *Pseudomonas*.
- Sexually transmitted diseases: *Treponema*, *Neisseria gonorrhoea*, *LGV agent*, *Chlamydiae*, and *Haemophilus ducreyiei*.

Unit – III

Study of etiology, cultivation, antigenic structure, pathogenesis, laboratory diagnosis, prevention and treatment of

- Airborne infections: *Influenza virus*, *Rhinovirus*, *Adenovirus*, *Mumps*, *Measles*.

- b. Zoonotic viral infections: *Rabies virus, Japanese encephalitis*
- c. Water born, contact and sexually transmitted diseases: *HAV, HBV, Entero virus, HSV, HIV*
- d. Mode of action of antimicrobial drugs on cell wall, nucleic acids, protein synthesis, enzyme inhibitors, cell membrane disruptors, anti-metabolites, Drug resistance and side effects.

Unit - IV

- a. Study of etiology, pathogenesis, epidemiology and prevention of Amoebiasis, Malaria, Ascariasis, Ancylostomiasis and Filariasis.
- b. Study of etiology, pathogenesis, epidemiology and prevention of Dermatophytosis (*Microsporum, Trichophyton* and *Epidermophyton*) and sub-cutaneous (Sporothrix, Mycetoma).
- c. Endemic mycosis: Coccidiomycosis, Histoplasmosis.
- d. Opportunistic mycosis: Candidiasis, Cryptococcosis, Aspergillosis.

Recommended Books

1. Arnold, 1998 Medical Microbiology, Volume 4
2. Bernard, Davia, Dulbecco Microbiology (4th edition)
3. Blackwell, 1993. Modern Parasitology : A Text Book of Parasitology (2nd Ed.) Cox FEG,
4. Brooks, G.F., J.S. Butel and S.A. Morse, Mc Graw – Hill Medical Microbiology
5. Christie AB, Edinburgh, Churchill – Livingstone Infectious diseases : Epidemiology and clinical practice (4th ed.)
6. Chung KJ, Bennett JE, Lea & Febiger, 1992 Medical Mycology
7. Kwon – Topley & Wilson's Microbiology and Microbial infections (9th Ed.) Ajello L, Hay
8. Churchill Livingstone, Davies et al 2nd edition. Microbiology
9. Churchill Livingstone, 1996 Practical Medical Microbiology (14th ed.)
10. Cruickshank Medical Microbiology Vol. I and II
11. DH *et al* (ed.) American Society for Microbiology, 1993 Diagnostic Molecular Microbiology,
12. Evans EGV *et al* (ed.) Medical Mycology, Oxford : Oxford University Press.
13. Jawetz, Melnick & Adebery Reviews of Medical Microbiology
14. Jayaram Paniker. Text book of Medical parasitology (4th edition)
15. Jhon Bernard Clinical diagnosis and management – Laboratory methods
16. Joklik, Wille, Amos & Wilfert Zinser Microbiology
17. Longman, 2000 Test Book of Microbiology
18. Macowiak PA N. Engl J. Med. 1982 The normal microbial flora 307: 83
19. Mandell, Douglas and Bennett's 2000 Principles and Practice of infectious diseases 5th edition
20. Mosby Bailey and Scott's Diagnostic microbiology
21. Murray PR *et al* (Ed.) American Society for Microbiology 1999 Manual of clinical Microbiology
22. Panjarathinam R Orient Longman. Text book of Medical Parasitology. Principles and Applications,
23. Reppon JW, Philadelphia: WB Saunders, 1988 Medical Mycology,
24. Richmann, DD *et al* Churchill Livingstone, 1997 Clinical virology,
25. Skinner, FA and Carr, JG (ed.) 1974 The Normal Microbial Flora of Man, Academic Press,
26. Yu VL, Merrigan TC Jr. Barriere William & Wilkins, 1999 Antimicrobial therapy and vaccines
27. Franklin, T.J. and G.A. Snow 2008 Biochemistry and Molecular Biology of Antimicrobial Drug Action. Springer International Edition England
28. Medical Microbiology by Sherries

Semester - IV
Paper - III
MBT 403 (A): MICROBIAL TECHNOLOGY

Unit – I

- a. Microbes important in food microbiology: yeasts, filamentous fungi and bacteria contamination of foods.
- b. Factors influencing food spoilage (intrinsic and extrinsic)
- c. Food poisoning and food borne infections (bacterial, viral, fungal and protozoa), bacterial and fungal toxins.
- d. Detection of microbial contamination of foods: Direct microscopic count (DMC), standard plate count, MPN method, reductase tests, membrane filters and molecular methods

Unit – II

- a. Contamination and spoilage of cereals, cereal products, fruits, vegetables, meats, meat products, fish, sea foods, eggs, poultry and canned foods.
- b. General principles of food preservation- Physical and Chemical methods.
- c. Dairy microbiology: Normal flora of milk and milk products, Spoilage of milk and milk products. Fermented milk products: acidophilus milk, bifidus milk, yoghurt manufacture of cheese, evolution of quality milk
- d. Microbial food fermentation: Fermentation in food processing, role of microorganisms in food fermentation. Microbial products of food; SCP, mushrooms, oriental foods Fermented beverages (fruit and cereal based) and fermented meat and meat products.

Unit – III

- a. Yeasts fermentation and yeast products: Production of active dry baker's yeast, instant yeast, quality of baker's yeast, production of brewer's yeast, wine yeast food and fodders yeast.
- b. Industrial production of enzymes: cellulases, amylases, proteases, phytases, pectinases, lipases, glucose isomerases, Immobilization of enzymes and cells and their applications.
- c. Scope, utility and methodology of biotransformation, biotransformation of antibiotics, steroids and non – steroids.
- d. Probiotics and Synbiotics. Food sanitation, food control agencies and their regulations.

Unit – IV

Industrial production of

- i) Biopesticides – Bacterial, viral and fungal
- ii) Biofertilizers – Nitrogen fixers, PSM, mycorrhizae
- iii) Biopolymers – Extracellular polymers, xanthans, dextrans, poly β hydroxyl alkanates
- iv) Biosurfactants - Classification, production and application
- v) Vaccines – Bacterial and viral vaccines.

Recommended Books

1. Adams, M.R. and Moss. M.O. 2007 Food Microbiology Royal society of Chemistry Pub Cambridge.
2. Banwart, G.S. 1989 Basic Food Microbiology
3. Chaplin, M.F. & Bucke.C 1990 Enzyme Technology Cambridge.
4. Diliello Methods in Food and Dairy Microbiology
5. Ealters, R.W. (Ed) 1992 Vaccines: New Approaches to immunological problems, B.H. London.
6. Fellows P. J 2009 Food Processing Technology Principles and Practice, Third Edition Published by: CRC Press
7. Frazier, W.C. and Werthaff, D.C. 1998 Food Microbiology 4th edition. Tata Mc Grow Hill New

Delhi

8. [http:// WWW.sallys-place.com/beverages/beer/beer_is_made.htm](http://WWW.sallys-place.com/beverages/beer/beer_is_made.htm)
9. <http://WWW.Indianfoodindustry.net/>
10. Hui Y H 2006 Food Biochemistry and Food Processing Blackwell
11. Jay. J.M. 1991 Modern food microbiology. 4th ed Van Nostrand Reinhold Co. New York.
12. Joshi, V.K. Ashok Pondey 1999 Biotechnology and Food fermentation Vol. I & II.
13. Katherine Smart 2003 Brewing Yeast Fermentation Performance John Wiley & Sons Inc
14. Prescott and Dunn's, Industrial Microbiology 4th edition.
15. Robison, R.K. 1990 Dairy Microbiology.
16. Thomas J. Montville, Karl Matthews, 2005 Food Microbiology: An Introduction: Amer Society for Microbiology

Semester – IV

Paper – III

MBT 403 (B): PHARMACEUTICAL MICROBIOLOGY

Unit I

- a. Microorganisms affecting pharmaceutical industry – The atmosphere, water, skin & respiratory flora of personnel, raw-materials, packing, equipments, building, utensils etc.
- b. Types of microorganisms occurring in pharmaceutical products. Microbiological spoilage prevention of pharmaceutical products.
- c. Preservation of pharmaceutical products; antimicrobial agents used as preservatives, evaluation of the microbial stability of formulation.
- d. Sterilization in pharmaceutical industry. Good manufacturing practices in pharmaceutical industry

Unit II

- a. History of chemotherapy – plants and arsenicals as therapeutics, Paul Ehrlich and his contributions, selective toxicity and target sites of drug action in microbes.
- b. Development of synthetic drugs – Sulphanamides, antitubercular compounds, nitrofurans, nalidixic acid, metronidazole group of drugs.
- c. Antibiotics - The origin, development and definition of antibiotics as drugs, types of antibiotics and their classification. Non-medical uses of antibiotics.
- d. Cosmetics microbiology- testing methods and preservation. Antimicrobial preservation efficacy and microbial content testing

Unit III

- a. Principles of chemotherapy – Clinical and lab diagnosis, sensitivity testing, choice of drug, dosage, route of administration, combined/mixed multi drug therapy, control of antibiotic/drug usage.
- b. Mode of action of important drugs – Cell wall inhibitors (Betalactam – eg. Penicillin).
- c. Bacterial resistance to quinolones. membrane inhibitors (polymyxins), macromolecular synthesis inhibitors (streptomycin), antifungal antibiotics (nystatin)
- d. Rapid screening of multi drug resistant bacterial genes from different sources

Unit IV

- a. The drug resistance – The phenomenon, clinical basis of drug resistance, biochemistry of drug resistance, genetics of drug resistance in bacteria.
- b. Microbiological assays: Assays for growth promoting substances, nutritional mutants and their importance, vitamin assay, amino acid assay
- c. Assay for growth inhibiting substances – Assay for non-medicinal antimicrobials (Phenol coefficient/RWC). Drug sensitivity testing methods and their importance. Assay for antibiotics –
- d. Determination of MIC, the liquid tube assay, solid agar tube assay, agar plate assay (disc diffusion, agar well and cylinders cup method). Introduction to pharmacokinetics and pharmacogenomics.

Recommended Books

1. Disinfection, sterilization and preservation. Block, S.S. (ed). Lea and Febigor, Baltimore
2. Pharmaceutical Microbiology. Hugel, W.B. and Russel, AD. Blackwell Scientific, Oxford
3. Principles and methods of sterilization in health sciences. Perkins, JK. Pub: Charles C. Thomas, Springfield.
4. American Public Health Association, Washington, D.C. Disinfectants: Their use and evaluation of effectiveness. Collins, CH., Allwood, MC., Bloomfield, SF. And Fox, A. (eds). Pub: Academic Press, New York
5. Inhibition and destruction of microbial cell by Hugo, WB. (ed). Pub: Academic Press, NY
6. Manual of Clinical Microbiology. Lennette, EH. (ed). Pub: American Society for Microbiology, Washington.
7. Principles and Practices of disinfection. Russell, AP., Hugo, WB., and Ayliffe, GAJ. (eds). Publ. Blackwell Sci.
8. Biochemistry of antimicrobial action. Franklin, DJ. and Snow, GA. Pub: Chapman & Hall.
9. Antibiotics and Chemotherapy. Garrod, L.P., Lambert, HP. And C'Grady, F. (eds). Publ: Churchill Livingstone.
10. Antibiotics. Lancini, G. and Parenti, F. Pub: Springer-Verlag.
11. The Molecular Basis of antibiotic action. Ga.e, EF. et al. Publ: Wiley, New York.
12. Antimicrobial Drug action. Williams, RAD., Lambart, PA. & Singleton, P. Pub: Bios Sci.
13. Microbiological Assays. Hewitt.
14. Antiviral Drugs. Kargor, S.
15. Burger's Medicinal chemistry Vol. I – III. Ed. Nanfield E. World.
16. The control of antibiotic resistant bacteria. Stuart, Harris and Harris.
17. Indian Pharmacopea; United States Pharmacopea; British Pharmacopea.

SEMESTER – IV Paper –IV

MBT 404 (A): NANOTECHNOLOGY & REGULATION OF MICROBIAL PRODUCTS

Unit – I: Nanotechnology - Concepts and Techniques

- a. Basic definition – origin – fundamental concepts- longer to smaller (a material perspective); simple to complex (a molecular perspective)
- b. Chemical precipitation and co-precipitation; Metal nano crystals by reduction, Sol gel synthesis- Micro emulsions or reverse micelles, micelle formation- Chemical Reduction- Emulsions, and dendrimers - Solvothermal synthesis- Thermolysis routes, Microwave heating synthesis- Sonochemical synthesis- Electrochemical synthesis- Photochemical synthesis.
- c. Characterization of nanoparticles – UV-VIS, SEM, FTIR, NMR, XRD, Passive nanostructures, active nanostructures.
- d. Green synthesis of silver nanoparticles – polysaccharide method, Tollens method, Irradiation method, Biological method, Poloxometalates method. Mechanism of antimicrobial action of nanoparticles – AgNps as a new generation of antimicrobials.

Unit – II: Nanotechnology – Applications

- a. **Environmental treatments:** Air disinfection, water disinfection, groundwater and biological waste water disinfection, surface disinfection, Bioremediation. Nano membranes, nano filters, Environment sensing. Emerging opportunities for microbial control and integrated urban water management
- b. **Biomedical and pharmaceutical:** Nanoparticles in bone substitutes and dentistry – Implants and Prosthesis - Reconstructive Intervention and Surgery – Nano robotics in Surgery – Photodynamic Therapy – Nano sensors in Diagnosis -Drug delivery – Therapeutic applications.
- c. **Agriculture and food technology:** Nanotechnology in Agriculture -Precision farming, Smart delivery system – Insecticides using nanotechnology –Potential of nano-fertilizers – Nanotechnology in Food industry - Packaging, Food processing - Food safety and biosecurity – Contaminant detection – Smart packaging.

- d. **Textiles and cosmetics:** Nanofibre production - Electrospinning – Controlling morphologies of nano-fibers – Polymer nanofibers - Nylon-6 nano composites from polymerization - Nano-filled polypropylene fibers -Bionics– Swim-suits with shark-skin-effect, Soil repellence, Lotus effect – Nano-finishing in textiles Lightweight bulletproof vests and shirts, Waterproof and Germ proof, Cleaner kids clothes, Wired and Ready to wear. Cosmetics – Formulation of Gels, Shampoos, Hair-conditioners (Sun-screen dispersions for UV protection using Titanium oxide – Color cosmetics).

Unit-III

- a. The concept of intellectual property- The history and evolution of patents, the effect of intellectual property protection on economic and technological development- industrial property rights and development.
- b. Patents: copy right and neighboring rights, patents for invention, utility models, industrial designs, trademarks, trade names and geographical relations, unfair competitions.
- c. Forms of intellectual property protection, conditions for patentability: patentable subject matter, industrial applicability, novelty, inventive step, disclosure of the invention.
- d. Drafting and filing a patent application, infringement, copyright and development, exploitation of patented invention. International treaties and conventions with special reference to biodiversity; Indian patent laws.

Unit- IV

- a. Genetically engineered microorganisms and their products: release of genetically engineered microorganisms and their products and their impact on the environment (food, water, air) and human health, hazard identification and risk management, field tests for genetically modified microorganisms.
- b. Concept of biosafety, biosafety levels, biocontainment, good microbiological practices, biosafety guidelines.
- c. Biohazard: Levels of biohazard, biological weapons, biosecurity, components of biosecurity program, bioethical issues.
- d. Requirements and procedures for recombinant DNA: Registration, review and approval of rDNA research; general approval procedure for rDNA products and genetically modified microorganisms.

Recommended Books

1. Alexander I. Poltorak and Paul J. Lerner Essentials of Intellectual Property
2. Holland, Catherine J. Intellectual Property: Patents, Trademarks, Copyrights, Trade Secrets (Author), Canuso, Vito A., Reed, Diane M.
3. Stephen Elias An Patent, Copyright & Trademark: An Intellectual Property Desk Reference (Author), Richard Stim
4. Chawla A Copyright and Related Rights
5. Christopher May, Susan K. Sell Intellectual Property Rights
6. Shiv Sahai Singh Law of Intellectual Property Rights
7. Virginia Baldwin Patent and Trademark Information: Uses and Perspectives
8. Indian Patent Law: Legal and Business Implications
9. Ajit Parulekar, Sarita D'Souza Bioethics and Biosafety in Biotechnology V Sree Krishna
10. WHO Laboratory manual 3rd edition 2004. Laboratory Biosafety and Biosecurity Guidance
11. CDC/NIH Biosafety in Microbiological and Biomedical Laboratories 5th edition, 2007
12. Gilbert P R Biotechnology Ethics Risks and Code of Conduct
13. Ashok Kumar Agricultural Biotechnology
14. Mark Kortepeter Biohazard 9-1-1
15. Young, Tomme Genetically Modified Organisms: A Guide to Biosafety Tzotzos, George
16. Sue Carson, Dominique Robertson Manipulation and Expression of Recombinant DNA, 2nd Edition

Semester – IV
Paper - IV
MBT 404(B): INDUSTRIAL WASTE MANAGEMENT

UNIT – I

- a. Types and Characterization of industrial wastes: Types of industrial wastes. General characteristics of different industrial wastes, pH, suspended solids, volatile solids, COD, BOD and organic carbon
- b. Effects of industrial wastes on aquatic life- Effects of industrial wastes of high BOD, effects of waste with toxicants.
- c. Self purification in natural waters: Introduction, physical process, chemical process, biological process.
- d. Eutrophication, global warming, acid rains and significance.

UNIT – II

- a. Microbiology and biochemistry of wastewater treatment: introduction. Cell physiology and important microorganisms.
- b. Role of enzymes, principles of growth, plasmid borne metabolic activities
- c. Impact of pollutants on biotreatment
- d. Methods of industrial waste treatment: Part-I:- Physico-chemical Methods - neutralization, oxidation of cyanides, Chromium reduction, reverse osmosis, carbon adsorption, destruction of phenolic compounds.

UNIT – III

- a. Methods of industrial waste treatment: Part-II:- Biological methods – I. Activated sludge process- Process, microbiology, sludge bulking. Trickling filters- Process, Microbiology and applications
- b. Methods of industrial waste treatment: Part-III:- Biological methods – II. Lagooning- Aerobic and anaerobic, applications.
- c. Anaerobic digestion- Process, microbiology of bio-gas formation, applications.
- d. Biomanagement of industrial waste: technological options for treatment of liquid and solid wastes – bioaugmentation, packaged microorganisms, use of genetically engineered microorganisms in wastewater treatment.

UNIT – IV

- a. Industrial waste treatment: methods of treatment of wastes from Dairies, Distilleries, paper and pulp industries, fertilizer industries and Pharmaceutical industries
- b. Waste disposal control and regulations: Water pollution control, Regulation and limits for disposal into lakes, rivers, oceans and land
- c. Novel methods in pollution control: Vermicomposting, treatment using aquatic plants, root zone processes.
- d. Hazardous wastes – Physico-chemical treatment – solidification – incineration – Secure land fills

Recommended Books

1. Industrial Pollution Control Vol. - I by E. J. Middlebrooks
2. The treatment of industrial wastes. (2nd ed) by E. B. Besselievre and M. Schwartz
3. Environmental Biotechnology (Industrial pollution management) by S. N. Jogdand, Himalaya Publishing House
4. Water and water pollution Handbook Vol. – I by Leonard L. Ciaccio
5. Wastewater Treatment by M.N. Rao and A. K. Datta
6. Industrial Pollution by N. L. Sax. Van Nostrand Reinhold Company
7. Encyclopaedia of Environmental Science and Technology Vol. – II by Ram Kumar
8. Water Pollution Microbiology by R. Mitchell
9. Handbook of Water Resources and Pollution Control by H.W. Gehm and J. I. Bregman
10. Environmental Microbiology by P. D. Sharma, Narosa Publishing House, New Delhi

Semester - IV
Practical Paper- I

MBP 405: ENVIRONMENTAL MICROBIOLOGY & MEDICAL MICROBIOLOGY

1. Determination of Biochemical Oxygen Demand (BOD) of sewage water
2. Determination of Chemical Oxygen Demand (COD) of industrial waste water
3. Bacteriological examination of water using multiple tube fermentation test: presumptive test, confirmed test and completed coli form test.
4. Estimation of Gross primary productivity (GPP), Net primary Productivity (NPP), and Respiratory Consumption (RC) to determine the autotrophic/heterotrophic status of aquatic bodies
5. Estimation of phosphates, sulphates and nitrates (eutrophication factors) in polluted and unpolluted water bodies
6. Disinfection of potable water by chlorine (bleaching power method) – determination of chlorine demand and residual chlorine
7. Biomonitoring of water quality by algal indices: Nygaard's index, Palmer's index, Kothe's index, Margalef's index.
8. Bioremediation of heavy metals : chromium/cadmium/lead
9. Phytoremediation of toxic metals by cyanobacterial species
10. Assay of lignolytic enzymes (lignin peroxidase and laccase) by white rot fungi
11. Decolourization of dye effluents by immobilized bacteria and fungi
12. Biotransformation of coal by *Thiobacillus ferrooxidans*
13. Air sampling by Petri plate method/gravity slide method/tilak air sampler
14. Estimation of xylanase enzyme : Role in biopulping
15. Preparation of different types of culture media, staining techniques – Gram's staining, F.B. staining, Albert staining, Capsular staining etc.
16. Identification of various pathogenic bacteria by biochemical, enzymatic and serological methods.
17. Bacteriological examination of urine, blood, pus, sputum, stools etc. from patients for diagnosis.
18. Cultivation of viruses.
19. Egg inoculation methods.
20. Tissue culture techniques.
21. Animal inoculation technique.
22. Microscopic studies of virus infected materials.
23. Potency test for vaccines.
24. Toxicity test for vaccines.
25. Handling of lab animals.
26. Examination of pathogenic fungi.
27. Examination of stools for helminthes & Amoeba.
28. Examination of blood smears to identify malarial parasite.
29. Isolation, observation and identification of normal microbial flora of human body.

FACULTY OF SCIENCE

M.Sc. MICROBIOLOGY

Practical Examination

MBP 405: ENVIRONMENTAL MICROBIOLOGY & MEDICAL MICROBIOLOGY Semester - IV Question Bank Paper - I

Time: 4 Hrs

Max. Marks: 100

1. Major Experiment

25 Marks

1. Determination of Biochemical Oxygen Demand (BOD) of sewage water
2. Determination of Chemical Oxygen Demand (COD) of industrial waste water
3. Bacteriological examination of water using multiple tube fermentation test: presumptive test, confirmed test and completed coli form test.
4. Estimation of Gross primary productivity (GPP), Net primary Productivity (NPP), and Respiratory Consumption (RC) to determine the autotrophic/heterotrophic status of aquatic bodies
5. Bioremediation of heavy metals : chromium/cadmium/lead
6. Phytoremediation of toxic metals by cyanobacterial species
7. Assay of lignolytic enzymes (lignin peroxidase and laccase) by white rot fungi
8. Air sampling by Petri plate method/gravity slide method/tilak air sampler

2. Major Experiment

25 Marks

1. Preparation of different types of culture media, staining techniques – Gram's staining, F.B.staining, Acid fast staining Albert staining, Capsular staining etc.
2. Bacteriological examination of urine, blood, pus, sputum, stools etc. from patients for diagnosis.
3. Examination of pathogenic fungi.
4. Examination of stools for Helminths & Amoeba.
5. Examination of blood smears to identify malarial parasite.
6. Isolation, observation and identification of normal microbial flora of human body.

3. Minor Experiment

10 Marks

1. Estimation of phosphates, sulphates and nitrates (eutrophication factors) in polluted and unpolluted water bodies
2. Disinfection of potable water by chlorine (bleaching power method) – determination of chlorine demand and residual chlorine
3. Biomonitoring of water quality by algal indices: Nygaard's index, Palmer's index, Kothe's index, Margalef's index.
4. Decolourization of dye effluents by immobilized bacteria and fungi
5. Biotransformation of coal by *Thiobacillus ferrooxidans*
6. Estimation of xylanase enzyme : Role in biopulping

4. Minor Experiment

10 Marks

1. Animal inoculation technique.
2. Microscopic studies of virus infected materials.
3. Potency test for vaccines.
4. Toxicity test for vaccines.
5. Handling of lab animals.
6. Cultivation of viruses.
7. Egg inoculation methods.
8. Tissue culture technique.
9. Identification of pathogenic bacteria by microscopy and biochemical tests.

5. Spotters Identification (4 Nos)

20 Marks

1. Multiple tube fermenter
2. Winogradsky column
3. Aeroflora agar plate
4. Dye effluent treatment
5. Decomposed litter Humus
6. Bioleaching rayon pulp
7. Desulphurised coal (Clean coal)
8. Drug sensitivity
9. TSIA slants
10. Small pox
11. Mumps
12. HSV infection
13. Staphylococcal skin Infection
14. Syphilis infection
15. Gas gangrene
16. *Corynebacterium* infection
17. EMB plate
18. Measles
19. Herpes vesicles
20. *Candida albicans* infection of the tongue
21. Athletes foot
22. Black piedra
23. Ring worm
24. *Microsporum*
25. Chromomycosis
26. *Madurella mycetomatis*
27. Blastomycosis
28. *Histoplasma capsulatum*
29. *Cryptococcus neoformans*
30. *Plasmodium*
31. Elephantiasis
32. Leishmaniasis
33. α -Haemolytic streptococci plate
34. β - Haemolytic streptococci plate
35. Proteolytic activity
36. Lipolytic activity

6. Record

10 Marks

Semester – I V Practical Paper - II

MBP 406 (A): MICROBIAL TECHNOLOGY

1. Enumeration of microorganisms from food, feed, vegetable and fruits.
2. Screening of mycotoxins from infected food material
3. Detection of microbial contamination in milk through direct microscopic count (DMC)
4. Detection of microbial contamination through MPN method.
5. Isolation and identification of yeast and formulation of Bakers yeast.
6. Wine production.
7. Methylene blue reductase test for milk quality.
8. Microbial reactions in litmus milk.
9. Assay of cellobiohydrolase.
10. Assay of endogluconase.
11. Production and assay of β - amylase.
12. Production and assay of α - amylase
13. Production and assay of protease.
14. Production and assay of lipase.
15. Production and assay of asparaginase.
16. Production and assay of Phosphatase.
17. Bio - transformation of organic compounds through MOS.
18. Formulation of Bio - pesticides (*Pseudomonas and Trichoderma* powder preparation).
19. Bioassay of antagonism microorganisms.
20. Seed coating of *Rhizobium* bacteria for N₂ fixation.
21. Screening of P- solubilizing microorganisms through plate method.
22. Extraction of bio – polymers.
23. Preparation of immobilized cells and fermentation
24. Isolation and identification of AM spores by wet sieving method.
25. Quantification of mycorrhizal root infection
26. Cultivation of mushrooms.

Spotters:

- | | |
|------------------------------------|-------------------------------|
| 1. Infected food | 23. <i>Aspergillus</i> |
| 2. Infected vegetables | 24. <i>Penicillium</i> |
| 3. Infected fruits | 25. <i>Fusarium</i> |
| 4. Aflatoxin | 26. <i>Cunninghamella</i> |
| 5. Mushroom spawn | 27. <i>Yeast</i> |
| 6. Cropping (Casing) | 28. <i>Alternaria</i> |
| 7. Litmus milk | 29. <i>Trichoderma</i> powder |
| 8. MBRT | 30. Antagonism microorganisms |
| 9. Biopesticides | 31. Immobilized cel |
| 10. VAM spores by funnel technique | |
| 11. Baker's yeast. | |
| 12. Foods Fermented beverages | |
| 13. Cheese | |
| 14. Idly | |
| 15. Curd | |
| 16. Alcohol | |
| 17. <i>Glomus</i> | |
| 18. <i>Gigaspora</i> | |
| 19. <i>Sclerocystis</i> | |
| 20. <i>Acaulospora</i> | |
| 21. <i>Scutellospora</i> | |
| 22. <i>Entrophospora</i> | |

Semester – I V
Practical Paper - II

MBP 406 (A): PHARMACEUTICAL MICROBIOLOGY

1. Sampling of pharmaceuticals for microbial contamination and load (syrups, suspensions, creams and ointments, ophthalmic preparations)
2. Bioassay of chlormphenicol by plate assay method or turbidometric assay method.
3. Determination of D value, Z value for heat sterilization in pharmaceuticals.
4. Neutralization test – Plaque neutralization, Haeme adsorption test.
5. Determination of antimicrobial activity of a chemical compounds (Phenol, resorcinol, thymol, formaldehyde) to that of phenol under Standardization experimental conditions.
6. Sterility testing methods for pharmaceutical and cosmetic products
7. Tests for disinfectants (Phenol coefficient/RWC)
8. Determination of antibacterial spectrum of drugs/antibiotics
9. Chemical assays for antimicrobial drugs
10. Testing for antibiotic/drug sensitivity/resistance
11. Determination of MIC valued for antimicrobial chemicals
12. Microbiological assays for antibiotics (Liquid tube assay, agar tube assay, agar plate assays)
13. Efficacy testing of preservatives like parabens

Spotters:

1. Syrups
2. Creams
3. Ointment
4. D-value
5. Z-value
6. Plaque neutralization
7. Heame adsorption test
8. Antimicrobial activity
9. Sterility testing
10. Tetracycline
11. Minimal inhibitory concentration (MIC)
12. Synthetic drugs
13. Cosmetic product (any available product)

Semester –I V
Practical Paper - II

MBP 406 (B): NANOTECHNOLOGY & REGULATIONS OF MICROBIAL PRODUCTS

1. Synthesis of nanoparticles by chemicals/enzymes/ microorganisms
2. SEM studies of nanoparticles.
3. Awareness and knowledge of Indian patent laws.
4. Drafting and filing a patent application.
5. Hazard identification and risk management of GEMS and risk management.
6. Knowledge of bio-safety guidelines.
7. Patent laws.
8. Biosafety guidelines.
9. Genetically engineered microorganisms.

Spotters:

1. Silver nanoparticles
2. Nano membranes
3. Nano filters
4. Nano robotics
5. Nano sensors
6. Nano fertilizers
7. Nano fibers

Semester – IV
Practical Paper - IV

MB 406(B): INDUSTRIAL WASTE MANAGEMENT

1. Sampling methods of soil and solid waste.
2. Solid waste characteristics
3. Physico-chemical properties of polluted soils.
4. Determination of moisture content, pH and conductivity of solid waste sample.
5. Determination of NPK in solid waste material.
6. Determination of C/N ratio
7. Quantification of chromium from tannery effluents.
8. Biological analysis of Municipal Solid waste.
9. Composting/Vermicomposting Experiments for the management of Solid Organic Waste.
10. Case studies on best practices of solid waste management.

Spotters:

1. Industrial waste
2. Eutrophication
3. Global warming
4. Biotreatment process
5. Reverse osmosis
6. Activated sludge
7. Trickling filters
8. Biogas production
9. Bioaugmentation
10. Vermicompost
11. Litter
12. Land fills

FACULTY OF SCIENCE
M.Sc. MICROBIOLOGY
Practical Examination
Semester - IV Question Bank Paper - II
MBP 306: MICROBIAL TECHNOLOGY/PHARMACEUTICAL MICROBIOLOGY
AND
NANOTECHNOLOGY AND REGULATION OF MICROBIAL PRODUCTS/WASTE
MANAGEMENT TECHNOLOGY

Time: 4 Hrs

Max. Marks: 100

1. Major Experiment	25 Marks
2. Major Experiment	25 Marks
3. Minor Experiment	10 Marks
4. Minor Experiment	10 Marks
5. Spotters Identification (4 Nos)	20 Marks
6. Record	10 Marks

FACULTY OF SCIENCE
M. Sc. MICROBIOLOGY
Model Question Paper (Theory)
Semester: I, II, III, IV Paper: I/II/III/IV

Time: 3 Hrs

Max. Marks: 80

Answer ALL questions. All questions carry equal marks.

Writ short notes on : (ONE question is to be set from each unit)
Each question carries 4 marks **4 x 4 = 16**

- a) **Question from Unit I**
- b) **Question from Unit II**
- c) **Question from Unit III**
- d) **Question from Unit IV**

Essay type questions: (TWO questions are to be set from each unit)
Each question carries 16 marks **4 x 16 = 64**

2. From Unit I

a)

Or

b)

3. From Unit II

a)

Or

b)

4. From Unit III

a)

Or

b)

5. From Unit IV

a)

Or

b)

FACULTY OF SCIENCE
M.Sc. MICROBIOLOGY
Practical Examination
Scheme of Question Paper (Practical)
Semester – I / II / III / IV, Paper - I, II, III, IV.

Time: 4 Hrs

Max. Marks: 100

1. Major Experiment **25 Marks**

- | | | |
|--|---|----------|
| a) Principle & procedure | - | 8 marks |
| b) Conducting experiment | - | 12 marks |
| c) Interpretation of results & conclusions | - | 5 marks |

2. Major Experiment **25 Marks**

- | | | |
|--|---|----------|
| a) Principle & procedure | - | 8 marks |
| b) Conducting experiment | - | 12 marks |
| c) Interpretation of results & conclusions | - | 5 marks |

3 Minor Experiment **10 Marks**

- | | | |
|--|---|---------|
| a) Principle & procedure | - | 3 marks |
| b) Conducting the experiment | - | 5 marks |
| c) Interpretation of results & conclusions | - | 2 marks |

4 Minor Experiment **10 Marks**

5. Spotting (4 Nos) (4x5=20) **20 Marks**

- | | | |
|-------------------|---|---------|
| a) Identification | - | 2 marks |
| b) Critical notes | - | 3 marks |

6. Record **10 Marks**

**DEPARTMENT OF MICROBIOLOGY
KAKATIYA UNIVERSITY
WARANGAL**

Day	Semester	Theory			1:00 – 2: 00 PM	Practicals
		10:00-11:00 AM	11:00-12:00 PM	12:00 – 1:00 PM		2:00 - 5:00 PM
MON	Sem I/II				L	
	Sem III/IV					
TUE	Sem I/II				U	
	Sem III/IV					
WED	Sem I/II				N	
	Sem III/IV					
THU	Sem I/II				C	
	Sem III/IV					
FRI	Sem I/II				H	
	Sem III/IV					
SAT	Sem I/II				BREAK	
	Sem III/IV					