

**SHIVAJI UNIVERSITY,  
KOLHAPUR.**

Syllabi of Ph.D /M.Phil. Course Work  
**Microbiology**

**A] Ordinance /Rules/ Regulations:-  
(as applicable to M.Phil. / Ph.D programme)**

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**B] Shivaji University, Kolhapur  
New/Revised Syllabus For Course work  
of M.Phil./Ph.D programme**

**TITLE : Microbiology.**

**1. Optional/Compulsory under the Faculty of Science**

**2. YEAR OF IMPLEMENTATION:-** New/Revised Syllabus will be implemented from June 2011 onwards.

**3. PREAMBLE:-**

The M.Phil / Ph.D course work shall involve Three Papers Viz.

- i. Research Methodology.
- ii. Recent Trends in the Subjects concerned.
- iii. Optional Paper (Base on Specialization)

**4. DURATION**

- **The M.Phil . programme shall be a full time regular course.**
- **The duration of M.Phil. programme shall be of One year.**

**5. PATTERN:-**

Pattern of Examination will be Annual in respect of M.Phil/  
(including dissertation) Semester in respect of Ph.D.

**6. FEE STRUCTURE :-**

**(as applicable to regular / self supporting course)**

- i. Entrance Examination Fee (If applicable ) – Rs -----  
(Non- refundable)**
- ii. Course Fee.**

<b>Particulars</b>	<b>Rupees</b>
<b>Tuition Fee</b>	<b>Rs.</b>
<b>Laboratory Fee</b>	<b>Rs.</b>
<b>Internet Fee</b>	<b>Rs.</b>

<b>Library Fee</b>	<b>Rs.</b>
<b>Annual /Semester fee- Per student</b>	<b>Total Rs.</b>

**7. ELIGIBILITY FOR ADMISSION:-**

As per eligibility criteria prescribed for each course and the merit list in the qualifying examination.

**8. MEDIUM OF INSTRUCTION:**

The medium of instruction shall be in English except Languages.

**9. STRUCTURE OF THE COURSE WORK FOR M.Phil/Ph.D.**

**(NO.OF PAPERS THREE )**

<b>Sr.No.</b>	<b>Subjects/Papers</b>	<b>Marks</b>
<b>1.</b>	Research Methodology	<b>100</b>
<b>2.</b>	Result Trends in the Subjects concerned	<b>100</b>
<b>3.</b>	Optional Paper (Based on Specialization)	<b>100</b> <b>(80 + 20)</b>
	<b>Total</b>	<b>300</b>

**10. SCHEME OF TEACHING AND EXAMINATION:-**

[The scheme of teaching and examination should be given as applicable to the course/paper concerned.]

<b>Sr.No.</b>	<b>Subjects/Papers (Hrs/Week)</b>				<b>Examination Schemes (Marks)</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Theory</b>	<b>Term Work/ Seminar</b>	<b>Total</b>	
<b>1.</b>	<b>60</b>				<b>100</b>			
<b>2.</b>	<b>60</b>				<b>100</b>			
<b>3.</b>	<b>40</b>	<b>20</b>			<b>80</b>	<b>20</b>		

**11. SCHEME OF EXAMINATION :-**

- The examination shall be conducted at the end of each academic year.
- The Theory paper shall carry 100 marks except paper III (80 marks)

- The evaluation of the performance of the students in theory papers shall be on the basis of Annual Examination of 100 marks.
- Question Paper will be set in the view of the /in accordance with the entire Syllabus and preferably covering each unit of syllabi.

**12. STANDARD OF PASSING:-**

As Prescribed under rules & regulation for each degree/programme.

**13. NATURE OF QUESTION PAPER AND SCHEME OF MARKING :-**

(Unitwise weightage of marks should also be mentioned)

**14. EQUIVALENCE IN ACCORDANCE WITH TITLES AND CONTENTS OF PAPERS- (FOR REVISED SYLLABUS)**

<b>Sr. No</b>	<b>Title of Old Papers</b>	<b>Titles of New Papers</b>
1.	Research Methodology	Research Methodology
2.	Recent Trends in Microbiology	Recent Trends in Biological Sciences
3.	Bioinformatics	Bioinformatics
4.	Bioremediation and Waste Water Treatment Technologies.	Bioremediation and Waste Water Treatment Technologies.
5.	Advanced Techniques in Cell Culture	Advanced Techniques in Cell Culture
6.	Agricultural Microbiology and Microbial Ecology	Agricultural Microbiology and Microbial Ecology
7.	Applied and Environmental Microbiology	Applied and Environmental Microbiology
8.	Immunology and Medical Microbiology	Immunology and Medical Microbiology
9.	Biotechnology	Fermentation Technology
10.	Clinical Biochemistry	Clinical Biochemistry

**15. SPECIAL INSTRUCTIONS , IF ANY.**

**New / Revised Syllabus for  
M.Phil./Ph.D. Course Work  
(Introduced from June 2011 onwards)**

**Syllabus for Microbiology.**

**i) Paper – I: (60 Lectures, 100 marks)**

**ii) Title of the Paper: Research Methodology**

**iii) Specific Objectives if any: To trend the research students in the analytical tools required during the M.Phil./Ph.D. Course and to develop computational skills.**

**Unit- I (15 Lectures)**

**Basic Concepts of Computer**

History of Computer, Concept of Computer hardware, Concept of Computer languages, Concept of Computer Softwares

**Computer applications in Biology**

Spreadsheet tools : Introduction to spreadsheet applications, features, Using formulas and functions, Data storing, Features for Statistical data analysis, Generating charts / graph and other features, Tools – Microsoft Excel or similar.

Presentation tools : Introduction, features and functions, Presentation of Power Point Presentation, Customizing presentation, Showing presentation, Tools – Microsoft Power Point or Similar.

Web Search: Introduction to Internet, Use of Internet and WWW, Use of search engines, Biological data bases.

**Unit- II (15 Lectures)**

**Biostatistics:** Measures of Central tendency and Dispersion. Probability distribution : Binomial, Poisson and Normal. Parametric and Nonparametric statistics, Confidence Interval, Errors.

**Quantitative Techniques:** Levels of significance, Regression and Correlation, Use of Statistics in Biosciences, Use of Computers in Quantitative analysis.

**Unit -III (15 Lectures)**

**Scientific Writing:**

**An Insight into Research:** Definition and basic concepts, objectives, significance and techniques of research, finding research materials – literature survey, compiling records.

a) Definition and kinds of scientific documents – research paper, review paper, book reviews, theses, conference and project reports (for the scientific community and for funding agencies).

- b) Components of a research paper– the IMRAD system, title, authors and addresses, abstract, acknowledgements, references, tables and illustrations.
- c) Dealing with publishers – submission of manuscript, ordering reprints.
- d) Oral and poster presentation of research papers in conferences/symposia.
- e) Preparation and submission of research project proposals to funding agencies

**Techniques in Molecular Biology:**

Identification and characterization of DNA, RNA, plasmids. Agarose gel electrophoresis, ethidium bromide staining. Southern, Northern, Western Blotting, RAPD, RFLP, DGGE, TGGE, PCR.

**Unit- IV**

**Research Techniques:**

Enzyme assay, enzyme activity and specific activity determination. Cell disintegration and extraction techniques, separation of proteins by fractionation (ammonium sulphate, organic solvents). Ion exchange chromatography, molecular sieve chromatography, affinity chromatography, paper chromatography, thin layer chromatography, ultra filtration, Ultracentrifugation. Gel electrophoresis, isoelectric focusing and immunoelectrophoresis, capillary electrophoresis, pulse field electrophoresis.

Microscopy, HPLC, HPTLC, GC-MS, FTIR, SEM/TEM, NMR, AAS.

**Suggested readings:**

1. Biostatistics : A foundation for Analysis in the Health Sciences 7/E Wayne W. Daniel, Wiley Series in Probability and Statistics.
2. Introductory Statistics. Fifth Edition. (2004) Prem S. Mann. John Wiley and Sons (ASIA) Pvt. Ltd.
3. Bioinformatics Methods and Applications Genomics, Proteomics, and Drug Discovery (S. C. Rastogi, N. Mendiratta, and P. Rastogi).
4. Introduction to Bioinformatics, (Atwood, T. K. and Parry-Smith, D. J).
5. Protein Purification by Robert Scopes, Springer Verlag Publication, 1982
6. Tools in Biochemistry David Cooper
7. Methods of Protein and Nucleic acid Research, Osterman Vol I – III
8. Centrifugation D. Rickwood
9. Practical Biochemistry, V th edition, Keith Wilson and Walker.
10. Bioinformatics by David Mound
11. Practical Biochemistry, Vth edition, Keith Wilson and Walker.
12. Protein Purification by Robert Scopes, Springer Verlag Publication, 1982
13. Tools in Biochemistry David Cooper
14. Methods of Protein and Nucleic acid Research, Osterman Vol I – III
15. Centrifugation D. Rickwood

**Paper-II:**

**(60 Lectures, 100 marks)**

**Title of the paper: Recent Trends in Biological Sciences**

## **Unit I**

**(15 Lectures)**

### **Gene Technology:**

Enzymes: DNA polymerase, restriction endonucleases, topoisomerase I and DNA ligase, reverse transcriptase, kinase, alkaline phosphatase, nuclease, RNase H.

Vectors: plasmids;(Ti/Ri), Cosmids, bacteriophage, M13 vectors, BAC, YAC and synthetic plasmids.

DNA sequencing dideoxy chain termination and Sanger's +/- method.

cDNA library – screening by oligonucleotide probe, nick translation, site directed mutagenesis, linkage analysis.

Gene cloning- General strategy for gene cloning, transformation.

Application of gene technology, Gene Silencing, Geneknock out and gene therapy

## **Unit II**

**(15 Lectures)**

### **Immunology:**

Complement fixation, structure and classes of antibodies, genetic basis of antibody diversity.

MHC I and II: structure and antigen presentation.

T and B lymphocytes activation and role in humoral and cell mediated immunity.

Vaccines live and attenuated, killed, multi-subunit and DNA vaccines.

Hypersensitivity and auto immune diseases. ELISA, RIA, Hybridoma Technology.

## **Unit III**

**(15 Lectures)**

### **Tissue culture Techniques:**

a) Animal Culture: Media requirements and sterilization techniques, primary and established cell lines. Culture methods: hanging drop, monolayer and suspension.

Advantages and disadvantages. Scale up methods. Roux tubes roller bottles.

Stem cells: adult and embryonic, applications to tissue engineering.

Applications of animal cells.

b) Plant tissue culture:

Cell and callus culture, anther culture. Micropropagation, somatic cell hybridization, protoplast fusion, cybrids, artificial seeds, Agrobacterium mediated gene transfer and use of Ti plasmid. Applications of plant tissue culture engineering, pathogen resistance (BT gene), herbicide tolerance, salt tolerance, production of secondary metabolites and transgenic plants.

## **Unit IV**

**(15 Lectures)**

### **Biofertilizers:**

Symbiotic free nitrogen fixers, asymbiotic free nitrogen fixers, algal, phosphate solubilizing, mycorrhizae and green manure.

a. Recent advances in Bacterial Taxonomy -

i. Identification of Prokaryotes

ii. A phylogenetic backbone and taxonomic framework for prokaryotic systems

- iii. A road map to the use of the current Bergey's Manual
- iv. Computer taxonomy
- v. 16s rRNA fingerprinting and lipid profile by GLC
- b. Microbial sources of pharmaceutically important compounds.
- c. Quorum sensing and microbial hormones – intercellular signaling.
- d. Biosensors – living biosensors for the management and manipulation of microbial consortia

**Suggested readings:**

1. Bergey's Manual of Systematic Bacteriology (2nd Ed.), Volumes 1 to 4 Springer
2. The Search for Bioactive Compounds from Microorganisms by S. Omura
3. Continuous Culture (Vol. 8) by A. C. R. Dean, D. C. Ellwood and C. G. T. Evans
4. Annual Reviews in Microbiology Volumes 46 & 48 by L. N. Ornston, A. Balows and E. P. Greenberg (eds). Academic Press
5. Biotechnology: Current Progress Volume 1 by P. N. Cheremisinoff and L. M. Ferrante. Technomic Publishing Co. Inc
6. Advances in Applied Microbiology volumes 6, 10, 17 by D. Perlman and Umbreit (eds). Academic Press.
7. The Physiology and Biochemistry of Prokaryotes by D. White. Oxford University Press
8. Sambrook J, Fritsch E. F. and Maniatis (1989) Molecular cloning, vol. I, II, III, II nd edition, Cold spring harbor laboratory press, New York.
9. DNA Cloning : A practical approach D.M. Glover and D.B. Hames, RL Press, Oxford, 1995
10. Molecular and cellular methods in Biology and Medicine, P.B. Kaufman, W. Wu , D. Kim and L.J. Cseke, CRC Press Florida 1995
11. Methods in Enzymology Guide to Molecular Cloning Techniques, Vol. 152 S.L. Berger and A. R. Kimmel, Academic Press Inc, San Diego, 1996
12. Methods in Enzymology Gene Expression Technology, Vol. 185D. V. Goedel, Academic Press Inc, San Diego, 1990
13. DNA Science: A First Course in Recombinant Technology, D. A. Mickloss and G. A Freyer, Cold Spring Harbor Laboratory Press, New York, 1990
14. Molecular Biotechnology, 2<sup>nd</sup> Ed. S. B. Primrose, Blackwell Scientific publishers, Oxford, 1994
15. Route Maps in Gene Technology, M. R. Walker, and R. Rapley, Blakwell Science, Oxford, 1997
16. Genetic Engineering : An Introduction to Gene Analysis and Exploitation in Eukaryotes, S. M. Kingsman, Blackwell Scientific Publications, Oxford, 1998
17. Kuby : Immunology; RA Goldsby, Thomas J. Kindt, Barbara A. Osborne.
18. Immunology by Roitt I. M., Brostoff J. and Male D. Gower medical publishing London.
19. Fundamentals of immunology 4<sup>th</sup> ed., Paul 1999, Lippencott Raven.

**Paper – III (Optional)**



**(80 Marks for theory exam and for 20 Marks for presentation of review of published papers in National/ International Journals for Ph. D course work and 10 + 10 marks seminar and review of papers respectively for M.Phil Cours).**

**Select any one from the following optional:**

**Paper-III A Bioinformatics**

(40 Lectures, 80 marks)

**Unit I**

**(10 Lectures)**

**Biological databases**

Genomes, DNA sequences. Sequence databases: GeneBank, European Molecular Biology Laboratory (EMBL) Nucleotide sequence databank, DNA Data Bank of Japan (DDBJ), Protein databases; primary databases and secondary databases, database formats. Structural databases; Protein Data bank (PDB), Nucleic Acid Data Bank (NDB), Molecular modeling Data Bank (MMDB).

**Sequence alignments**

Introduction, Protein sequences, physicochemical properties based on sequence, sequence comparison. Pair-wise sequence alignment, gaps, gap-penalties, scoring matrices, Smith-Waterman and Needleman-Wunsch algorithms for sequence alignments, multiple sequence alignment, comparison, composition and properties, useful programs, ClustalW, BioEDIT, BLASTp, Phylogenetic analysis tools- Phylip, ClustalW, Online phylogenetic analysis.

**Unit II**

**(10 Lectures)**

**Gene expression and DNA microarray**

Introduction, Basic steps for gene expression, genome information and special features, coding sequences (CDS), untranslated regions (UTR's), cDNA library, expressed sequence tags (EST). Approach to gene identification; codon-bias detection, detecting functional sites in the DNA. Internet resources for gene identification, detection of functional sites. Types of microarrays; Tools for microarray analysis; soft-finder, xCluster, MADAM, SAGE, Applications of microarray technology.

**Structural biology**

Nucleic acid structures, RNA folding, RNA loops, conformational study, various ribose ring conformations, ribose-ring puckering, protein-protein interactions, protein-ligand interactions, DNA-binding proteins, RNA-binding proteins, Ramachandran plot, , 3-dimensional structures of membrane proteins, importance of  $3^{10}$  helix and loops, biophysical aspects of proteins and nucleic acids.

**Unit III**

**(10 Lectures)**

### **Molecular modeling**

Introduction, force field, quantum chemistry, Schrödinger equation, potential energy functions, energy minimization, local and global minima, saddle point, grid search, various approximations; LCAO, HF, semi-empirical calculations; single point calculations, full-geometry optimization methods, ZDO, MNDO, CNDO, NDDO, AM1, PM3, RM1, conformational search, Z-matrix, docking, molecular modeling packages.

### **Protein structure prediction**

Protein Structure Prediction; Homology modeling, prediction of protein structure from sequences, functional sites, Protein folding problem, protein folding classes, protein identification and characterization; structure determination by X-ray and NMR

## **Unit IV**

**(10 Lectures)**

### **Molecular mechanics**

Definition, balls and springs, force fields, bond-stretching, bond-bending, dihedral motions, out of plane angle potential, non-bonded interaction, coulomb interactions, conformational search, united atoms and cut-offs, Derivative methods; First-order methods; Steepest descent, conjugate gradient, Second order methods; Newton-Raphson method.

### **Molecular dynamics**

Introduction, Newton's equation of motion, equilibrium point, radial distribution function, pair correlation functions, MD methodology, periodic box, algorithm for time dependence; leapfrog algorithm, Verlet algorithm, Boltzman velocity, time steps, duration of the MD run.

### **Bioinformatics applications**

Agriculture, Molecular biology, Environment, Biotechnology, Neurobiology, Drug Designing, Biomedical genome medicines.

### **Suggested readings:**

1. Bioinformatics Methods and Applications Genomics, Proteomics, and Drug Discovery (S. C. Rastogi, N. Mendiratta, and P. Rastogi).
2. Introduction to Bioinformatics, (Atwood, T. K. and Parry-Smith, D. J).
3. An introduction to Computational Biochemistry. (C. Stain Tsai, A John Wiley and Sons, Inc., publications).
4. Developing Bioinformatics Computer Skills. (Cynthia Gibas and Per Jambeck).
5. Molecular Modelling for Beginners ( Alan Hinchliffe).
6. A user guide to the UNIX system (Rebecca Thomas and Jean Yates)
7. <http://www.ncbi.nlm.nih.gov>

## **Paper-III B**

**(40 Lectures, 80 marks)**

### **Bioremediation and Waste Water Treatment Technologies.**

## Unit I

(10 Lectures)

### **Bioremediation, biotransformation and biodegradation.**

1. Bioremediation, *in situ* and *ex situ* bioremediation, constraints and priorities of bioremediation, Evaluating Bioremediation, Bioremediation of VOCs.
2. Biodegradation. Factors affecting on process of biodegradation. Methods in determining biodegradability. Contaminant availability for biodegradation.
3. Xenobiotics, Persistence and biomagnification of xenobiotic molecules. Microbial interactions with xenobiotics. Phase I and Phase II reactions. Cyt P 450 mediated reactions. Use of microbes (bacteria and fungi) and plants in biodegradation and Biotransformation.
4. Sources of heavy metal pollution, Microbial interactions with inorganic pollutants Microbial metal resistance, Microbial transformation, accumulation and concentration of metals, Biosorption Biotechnology and heavy metal pollution.

## Unit II

(10 Lectures)

### **Water pollution monitoring.**

1. Methods of monitoring.
2. Biological methods- Detection methods for DO, BOD, Pathogen monitoring by heterotrophic plate count, multiple tube method, membrane filtration methods, Other emerging techniques such as enzyme detection, hybridization, PCR, gene probe technology etc. Strategies for controlling pathogen transfer.
3. Chemical methods- Detection methods for COD, pH, alkalinity, TSS, TDS, Total organic carbon, oil, grease etc.

## Unit III

(10 Lectures)

### **Effluent treatment systems**

1. Sewage and waste water treatments systems. Primary, secondary and tertiary treatments. Measurement of treatment efficiencies. Biological treatments- aerobic versus anaerobic treatments. Environmental pollution control- Bioremediation, Bioaugmentation and Biostimulation.
2. Biofilms in treatment of waste water. Biofilm development and biofilm Kinetics. Aerobic Biofilms.
3. Bioreactors for waste water treatments. Reactors types and design. Reactors in series. Development and optimization of membrane bioreactor process for use in sanitary and industrial sewage treatment.

## Unit IV

(10 Lectures)

### **Biotechnological application of hazardous waste management and management of resources.**

1. Use of microbial systems.

2. Phytoremediation. Waste water treatment using aquatic plants, root zone treatment.
3. Development of new biocatalysts to be applied in waste water biotechnology.
4. Need for management of resources. Role of environmental biotechnology in management of resources. Reclamation of wasteland, biomass production, Biogas and biofuel production. Development of environmentally friendly processes such as integrated waste management.

**Suggested readings:**

1. Biotreatment Systems , Volume II ; D.L. Wise.
2. Advances in Biotechnological Process ; Mizrahi & Wezel.
3. Bruce Rittman, Perry L. McCarty. Environmental Biotechnology: Principles and Applications. McGraw-Hill 2nd edition (July 25, 2000) ISBN: 0072345535.
4. Raina M. Maier , Ian L. Pepper, Charles P. Gerba. Environmental Microbiology. Publisher: Academic Press; (February 23, 2000).
5. Martin Alexander. Biodegradation and Bioremediation. Academic Press; 2nd edition (April 15, 1999) ISBN: 0120498618.
6. Gabriel Bitton (Author). Wastewater Microbiology, 2nd Edition. Wiley-Liss; 2<sup>nd</sup> edition (February 16, 1999) ISBN: 0471320471.
7. Milton Wainwright. An Introduction to Environmental Biotechnology. Kluwer Academic Publishers, Boston. Hardbound, ISBN 0-7923-8569-1. July 1999, 192.
8. M.N.V. Prasad, Kazimierz Strzalka. Physiology and Biochemistry of Metal Toxicity and Tolerance in Plants. Kluwer Academic Publishers, Dordrecht Hardbound, ISBN 1-4020-0468-0. February 2002, 460 pp.
9. Biotechnology for Solving Agricultural Problems; Danforth & Bakst.
10. Introduction to Environmental Microbiology; R. Mitchell.

**Paper-III C**

(40 Lectures, 80 marks)

**Advanced Techniques in Cell Culture**

**Unit I**

**(10 Lectures)**

**Basic techniques in tissue culture**

Introduction to Cell & Tissue Culture. Design & lab setup of Tissue Culture laboratory, Tissue culture Media (Composition preparation), Types of culture.

Role of Plant Hormones in growth & development of Plants.

Micro propagation (Organogenesis, Somatic Embryogenesis, Shoot tip culture, Rapid clonal propagation, Embryo Culture & Embryo Rescue, Acclimatization of Plants)

Invitro mutagenesis. Cryopreservation, Slow growth & DNA Banking for germ plasm conservation.

**Unit II**

**(10 Lectures)**

### **Plant cell culture, plant transformation technology & its applications.**

Basics of Tumor formation, Hairy root, features of Ti & Ri Plasmid, Mechanism of DNA transfer role of Virulence gene, Use of Ti & Ri as vectors, Binary vectors, Use of 35s & other promoters genetic markers methods of nuclear transformation viral vectors & their applications, Multiple gene transfers vector less or direct DNA transfer, Use of reporter gene, Particle bombardment, electroporation, Microinjection, Transformation of monocots, Transgene stability & gene silencing in Plant transformation. Applications of Plant Transformation for Productivity & performance Herbicide resistance like atrazine, Insect resistance Bt gene, non Bt like protease inhibitors, Virus resistance, disease resistance, antibiotic stress, post harvest losses long shelf life of fruits & flowers. Chloroplast transformation, Advantage vectors & success with tobacco & potato Metabolic engineering & Industrial products

### **Unit III**

**(10 Lectures)**

Plant secondary metabolites, control mechanisms & manipulation of Phenyl Propanol pathway, Shikimate pathway, Alcoloids, Industrial enzymes, Biodegradable plastics, Therapeutic proteins, lysozomal enzymes, Antibodies, edible vaccines, Purification strategies, oleosin partitioning technology  
Integration of Genetic Engineering of Plants in Agriculture  
Diseases resistant, Biotic & Abiotic stress resistant, Enhancement of nutritional value of crop Plants & molecular farming

### **Unit IV**

**(10 Lectures)**

#### **Animal cell culture and tissue engineering.**

Cell lines, cell culture growth kinetics, Basic Techniques of mammalian cell culture (Open and closed cell-cultures, Primary Cell culture),  
Cell surgery and Cell Fusion Methods ( Preparation of anucleated cells and polykaryon cells, preparation of ghost RBCs, Preparation of mini cells, micro cells, Surgical manipulation of *in vitro* fertilization, Hybridoma cell preparations, Use of Hybridoma technology: e.g. M AB and other related techniques, Mini cells, micro cells and anucleated cells in fusion and their application.)  
Tissue Engineering: Capillary culture Units, feeder layers.  
Use of Animal Cells in Culture: Mutant cell preparation, Evaluation of Chemical carcinogenicity, Cell malignancy Testing, Toxicity Testing, Karyotyping and cytogenetic characterization, Production of metabolic products, ESC applications, Pluripotent stem cell applications.

#### **Suggested readings :**

1. An introduction to Plant Tissue Culture 2<sup>nd</sup> edn. Razdan, M. K, Science Publishers, USA.
2. Textbook of plant biotechnology, Chawla P.K.2002,Oxford&IBH,New Delhi.
3. Bhojwani, S. S. and M. K. Razdan 1996.Plant Tissue Culture: Theory and Practice, Elsevier Pub.
4. Chrispeels, M. J. 2002.Plant Tissue Culture:Genetical Aspects. Jones and Bortlett

- Publishers, International.
5. Chopra V. L. et al 1999. Applied Plant biotechnology. Science Publishers Inc.
  6. Verpoorte, R. and A.W. Alfermann (Eds) 2000. Metabolic Engineering of plant secondary metabolism, lower Academic Publisher.
  7. Kuchler, R.J., Biochemical Methods in cell culture and Virology, Dowden, Hutchinson and Ross, Inc. Strausberg, USA, 1977
  8. Morgan, S. I. Animal cell culture, 1993, Bio Scientific Publishers Ltd, Oxford.
  9. Freshney, R.I. Culture of Animal cells: A Manual of Basic Technique, 1994, John Wiley and Sons Inc. Publication, USA.
  10. Butler, M. Mammalian, cell Biotechnology: A Practical Approach (1991), IRL Press, Oxford.
  11. Jenni P. Mather and David Barnes, eds; Animal cell culture Methods, Methods in cell Biology, vol.57, Academic Press.
  12. Cell Culture: Methods in enzymology, Vol-58, Academic Press 1979 or recent.

**PAPER – III D:** (40 Lectures, 80 marks)  
**Agricultural Microbiology and Microbial Ecology**

**Unit I** (10 Lectures)

Soil Enzymes – origin and range of enzymes in soil, methods of measurement and extraction of soil enzymes, interactions between agrochemical and soil enzymes.  
 Recent advances in biological Nitrogen fixation  
 Microbial Biofertilisers.

**Unit II** (10 Lectures)

Epidemiology of plant diseases  
 Biological control of soil borne plant pathogens  
 New Directions and Importance of Microbial Ecology

**Unit III** (10 Lectures)

Microbiology of the Extreme Environment

- a. Hot springs, acid springs and lakes
- b. Microbial life in hyper saline environments – ecophysiological aspects, sea and salt lakes.
- c. Microbial life at low temperatures
- d. Microbiology to 10,500 metres under the deep sea.

**Unit IV** (10 Lectures)

Anaerobic Microorganisms – ecophysiological aspects, principles and techniques for the isolation, enumeration and identification of Methanogens, Dissimilatory Sulphate reducing and Anoxygenic Phototrophic bacteria  
Geomicrobiological processes – physiological and biochemical aspects, Methods in Geomicrobiology.  
Biodiversity as a source of innovation in Biotechnology

**Suggested Readings:**

1. Soil Enzymes by R. G. Burns
2. Chemistry and Biochemistry of Biological Nitrogen Fixation by J. R. Postgate. Plenum Press
3. Biofertilizers by L. L. Somani and others. Scientific Publishers, Jodhpur
4. Plant Pathology by J. C. Walker
5. Plant Diseases by R. S. Singh
6. Microbial Ecology by J. M. Lynch
7. Bergey's Manual of Systematic Bacteriology Volume 1. Springer
8. Annual Reviews in Microbiology Volumes 46 & 49 by L. N. Ornston, A. Balows and E. P. Greenberg (eds). Academic Press
9. Microbes in Extreme Environments by D. J. Kushner
10. Anaerobes by Shapton. Academic Press
11. Microbiological Aspects of Anaerobic Digestion – A Laboratory Manual by D. R. Ranade and S. V. Gadre (eds) Agharkar Research Institute, Pune.
12. Geomicrobiology by H. L. Ehrlich

**PAPER – III E:** (40 Lectures, 80 marks)  
**Applied and Environmental Microbiology**

**Unit I** (10 Lectures)

Hydrocarbon Fermentations  
Steroid Transformations  
Fermentative production of Cephalosporins and Tetracyclines

**Unit II** (10 Lectures)

Microbial catalysis in the generation of Flavour and fragrance chemicals  
Biosynthesis of Insect Pheromones and Ergot alkaloids  
Flux Control Analysis and Metabolic Engineering in Fermentation Microbiology.

**Unit III** (10 Lectures)

Microbiology and production of Lactic Starter Culture Concentrates  
Microbiology of Dried Milk Powders and Concentrated Milks.  
Quality Control in the Food and Dairy Industry – HACCP system.

**Unit IV** (10 Lectures)

Recent advances in Microbiological waste treatment methods -

- a. Activated Sludge Process
- b. Anaerobic sludge digestion
- c. Root zone technology
- d. Microbial biosorption technology
- e. Mass scale production of Effective Microorganisms (EM) for waste treatment.
- f. Economics of waste treatment

**Suggested Readings:**

1. Industrial Microbiology by L. E. Casida Jr. Wiley International Ltd.
2. Microbial Technology by H. J. Pepler. Academic Press
3. Annual Reviews in Microbiology Volume 48 by L. N. Ornston, A. Balows and E. P. Greenberg (eds). Academic Press
4. Enzyme Biotechnology by S. Sridhar
5. Food Microbiology by M. R. Adams and M. O. Moss
6. Dairy Microbiology Volumes 1 and 2 by R. K. Robinson.
7. Fermentation Microbiology and Biotechnology by E. M. T. El-Mansi and C. F. A. Bryce.
8. Microbiological Aspects of Pollution Control by Dart and Stretton. Surabhi Publishers, Jaipur
9. Treatment of Industrial Effluents by Callely, Forster and Stafford (eds). Hodder and Stoughton, London
10. Water Pollution Microbiology by R. Mitchell, Volumes 1 and 2.
11. Critical Efforts in Applied Chemistry, Vol.II – Topics in Wastewater Treatment by J. M. Sidwick (ed.). Blackwell Scientific Publishing
12. Industrial Wastewater Treatment by M. N. Rao and R. L. Datta.

**PAPER – III F:** (40 Lectures, 80 marks)  
**Immunology and Medical Microbiology**

**Unit I** (10 Lectures)

Immunoprophylaxis and Immunotherapy  
Regulation of Immune response

**Unit II** (10 Lectures)



Interleukins, Interferon and Lymphokines  
Recent developments in Monoclonal antibody technology  
In vitro synthesis of immunoglobulins, complement and other proteins

**Unit III** (10 Lectures)

Rapid Detection of Food borne Pathogenic Bacteria  
Pathophysiology of Infectious diseases – diseases of respiratory tract, digestive system, skin and soft tissues.

**Unit IV** (10 Lectures)

Molecular basis of Mycoplasma pathogenicity, AIDS associated Mycoplasma.  
Recent developments in aetiology, pathogenesis, diagnosis and control of AIDS.

**Suggested Readings:**

1. Microbiology in the Health Sciences and Diseases by R. Fuerst
2. Immunology – A Short Course by Benjamin and others Wiley – Liss Inc.
3. Immunology by Roitt. Published by Mosby
4. Lecture notes on Epidemiology and Community Medicines by Farner and Miller
5. Annual Reviews in Microbiology Volume 48 by L. N. Ornston, A. Balows and E. P. Greenberg (eds). Academic Press
6. Handbook of Practical Immunology by D. W. Weir Volumes 2 & 3
7. Basic and Clinical Immunology by Stites and others (eds). Lange Medical Publications
8. Mechanisms of Microbial diseases by M. Schwachter, G. Medoff and D. Schlessinger. Williams and Wilkins.
9. Mycoplasmas by J. Maniloff (ed). American Society for Microbiology
10. Biotechnology: Current Progress Volume 1 by P. N. Cheremisinoff and L. M. Ferrante. Technomic Publishing Co. Inc
11. Medical Bacteriology and AIDS by N. C. Dey and T. K. Dey

**Paper-III G:** (40 Lectures, 80 marks)

**Fermentation Technology**

**Unit I** (10 Lectures)

**Microbial fundamentals and biochemical engineering:**

Various methods for isolation of pure culture methods for measurement of microbial growth, manipulation of environment, nutritional and genetic parameters for over production of metabolites, maintenance and preservation of microbes (pure culture).

Design of production nutrient media, preparation of inoculum, alternative carbon and nitrogen sources, pretreatment of carbon, growth kinetics.

## **Unit II**

**(10 Lectures)**

Design of fermenter: material for construction, aeration, agitation, sterilization of gases and liquids, on-line and off line monitoring of rheological parameters, scale-up, computer application, types of fermenters, solid state (substrate) fermentation, process economics, fermentation economics.

## **Unit III**

**(10 Lectures)**

### **Applied Biotechnology:**

Organic solvents and acids: Alcohol, acetone-butanol, vinegar and citric acid.

Beverages: Wine, beer, rum, whisky.

Amino acids: Tryptophan, flavor enhancers- MSG.

Vitamins: Vitamin B12

Enzymes: Amylases, proteases.

Exopolysaccharides: Xylan.

## **Unit IV**

**(10 Lectures)**

Antibiotics: Penicillin, streptomycin, rifamycin, semisynthetic antibiotics.

Anticancer agents: Nucleoside analogs, enzyme-1-asparaginase, MAB, interferon.

SCP and SCO.

Bioplastics (PHA).

Biotransformation reactions.

Biopharmaceuticals: TPA.

Patent and Entrepreneurship.

### **Suggested Readings:**

1. Microbial Technology by H. J. Peppler. Academic Press
2. Annual Reviews in Microbiology Volume 48 by L. N. Ornston, A. Balows and E. P. Greenberg (eds). Academic Press
3. Enzyme Biotechnology by S. Sridhar
4. Food Microbiology by M. R. Adams and M. O. Moss
5. Dairy Microbiology Volumes 1 and 2 by R. K. Robinson.
6. Fermentation Microbiology and Biotechnology by E. M. T. El-Mansi and C. F. A. Bryce.
7. Microbiological Aspects of Pollution Control by Dart and Stretton. Surabhi Publishers, Jaipur

## **Paper-III H:**

**(40 Lectures, 80 marks)**

# Clinical Biochemistry

## Unit I

(10 Lectures)

### Enzymes:

Use of enzymes in the diagnosis and monitoring of myocardial infarction, liver diseases and pancreatic diseases.

Normal and abnormal serum values of the enzymes and their significance, acid and alkaline phosphatase, SGOT, SGPT,  $\alpha$ -amylase, LDH, creatine kinase, troponin T.

## Unit II

(10 Lectures)

### Blood chemistry:

Normal and abnormal constituents of blood, glucose, urea, uric acid, creatinine, bilirubin, and proteins. Lipid profile and its significance. Blood groups, Rh factor compatibility and blood transfusion. Hemoglobinopathies: anaemia, thalassemia, sickle cell anaemia.

## Unit III

(10 Lectures)

### Liver diseases:

Types of jaundice, molecular basis and biochemical assessment, viral hepatitis, alcoholic hepatitis, cirrhosis.

**Cardiac diseases:** Ischaemic heart disease, angina pectoris, myocardial infarction. Cardiac profile tests, atherosclerotic plaques.

Biochemical and other techniques used in clinical chemistry ELISA, RIA, IRMA.

Noninvasive techniques used in clinical practice, sonography, X-ray, MRI, CT Scan, ECG.

## Unit IV

(10 Lectures)

### Cancer:

Molecular basis, carcinogenesis, oncogenes, benign and malignant, metastasis, tumor markers and tumor staging.

**Genetic disorders:** Down's, Turner's and Klinefelter's diseases.

Infectious diseases at the outset of 21<sup>st</sup> century like AIDS, SARS, and Dengue.

Inborn errors of metabolism, metabolic disorders, diabetes.

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1. Immunology – A Short Course by Benjamin and others Wiley – Liss Inc.
2. Immunology by Roitt. Published by Mosby
3. Lecture notes on Epidemiology and Community Medicines by Farner and Miller

4. Handbook of Practical Immunology by D. W. Weir Volumes 2 & 3
5. Basic and Clinical Immunology by Stites and others (eds). Lange Medical Publications
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