

MICROBIOLOGY
Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
MICRO 501*	PRINCIPLES OF MICROBIOLOGY	3+1
MICRO 502*	MICROBIAL PHYSIOLOGY AND METABOLISM	3+1
MICRO 503*	MICROBIAL GENETICS	2+1
MICRO 504*#	SOIL MICROBIOLOGY	2+1
MICRO 505*@	MICROBIAL BIOTECHNOLOGY	2+1
MICRO 506*	FOOD AND DAIRY MICROBIOLOGY	2+1
MICRO 507	BACTERIOPHAGES	1+1
MICRO 508	ENVIRONMENTAL MICROBIOLOGY	2+1
MICRO 509**	PLANT-MICROBE INTERACTIONS	3+0
MICRO 510	INDUSTRIAL MICROBIOLOGY	2+1
MICRO 511	BIOFERTILIZER TECHNOLOGY	1+1
MICRO 512	CYANOBACTERIAL AND ALGAL BIOTECHNOLOGY	2+0
MICRO 591	MASTER'S SEMINAR	1+0
MICRO 599	MASTER'S RESEARCH	20
MICRO 601**	ADVANCES IN FERMENTATION	2+1
MICRO 602**	ADVANCED MICROBIAL PHYSIOLOGY	2+0
MICRO 603**	REGULATION OF MICROBIAL BIOSYNTHESIS	2+0
MICRO 604**	CURRENT TOPICS IN SOIL MICROBIOLOGY	2+0
MICRO 691	DOCTORAL SEMINAR I	1+0
MICRO 692	DOCTORAL SEMINAR II	1+0
MICRO 699	DOCTORAL RESEARCH	45

*Compulsory for Master's programme;

**Compulsory for Doctoral programme

#Can be cross-listed with Soil Science;

@Can be cross-listed with Biotechnology

Minor Departments

9

Plant Molecular Biology and Biotechnology

Biochemistry

Soil Science

Plant Pathology

Entomology

Supporting Departments

5

Statistics and Mathematics

Plant Molecular Biology and Biotechnology

Biochemistry

Soil Science

Plant Pathology

Entomology

Non credit compulsory courses

CODE	COURSE TITLE	CREDITS
PGS 501	LIBRARY AND INFORMATION SERVICES	0+1
PGS 502	TECHNICAL WRITING AND COMMUNICATION SKILLS	0+1
PGS 503 (e-course)	INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE	1+0
PGS 504	BASIC CONCEPTS IN LABORATORY TECHNIQUES	0+1
PGS 505 (e-course)	AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES	1+0
PGS 506 (e-course)	DISASTER MANAGEMENT	1+0

Objective

To teach the students about basics in development of microbiology, differences in prokaryotes and eukaryotic cell and classification of prokaryotes.

Theory**UNIT I**

Development of Microbiology in the 18th and 19th century. Morphology, structure and function of prokaryotic and eukaryotic cell. Archea. Classification of prokaryotes – Basic principles and techniques used in bacterial classification.

UNIT II

Evolutionary relationship among prokaryotes. Phylogenetic and numerical taxonomy. Use of DNA and r-RNA sequencing in classifications.

UNIT III

Study of major groups of bacteria belonging to Gracilicutes, Firmicutes, Tenericutes and Mendosicutes.

UNIT IV

Viruses – morphology, classification and replication of plant, animal and bacterial viruses. Cultivation methods of viruses. Immune response – specific and non-specific resistance. Normal microflora of human body; some common bacterial and viral diseases of humans and animals.

Practical

Preparation of different media, evaluation of different sterilization methods, isolation of microorganisms from air, water, milk, food and soil. Purification and maintenance of microorganisms isolated from water, milk, food, soil and air. Enrichment culture technique, Isolation of nitrogen fixing bacteria, photosynthetic bacteria. Use of selective media for isolation of auxotrophs and antibiotic producing microorganisms. Morphological characterization of bacteria. Biochemical tests for identification of bacteria.

Suggested Readings

Brock TD. 1961. *Milestones in Microbiology*. Infinity Books.

Pelczar MJ, Chan ECS & Kreig NR. 1997. *Microbiology: Concepts and Application*. Tata McGraw Hill.

Stainier RY, Ingraham JL, Wheelis ML & Painter PR. 2003. *General Microbiology*. MacMillan.

Tauro P, Kapoor KK & Yadav KS. 1996. *Introduction to Microbiology*. Wiley Eastern.

MICRO 502

MICROBIAL PHYSIOLOGY AND METABOLISM
(Pre-requisite Micro 501)

3+1

Objective

To teach students about cell cycle, growth and practical training on methods to determine microbial growth.

Theory

UNIT I

Structure, function, biosynthesis and assembly of various cellular components of prokaryotes. Archea and fungi. Transport of solutes across the membrane.

UNIT II

Microbial growth. Cell cycle and cell division. EMP, HMP, ED, TCA pathways, Aerobic and anaerobic respiration. Fermentative metabolism. Biosynthesis of macromolecules. Regulation of microbial metabolism.

UNIT III

Effect of chemicals and other environmental factors on growth. Morphogenesis and cellular differentiation.

UNIT IV

Important metabolic patterns in photoautotrophs, photoheterotrophs, chemoautotrophs and chemoheterotrophs.

Practical

Use of simple techniques in laboratory (Colorimetry, Centrifugation, Electrophoresis and GLC), Determination of viable and total number of cells, Measurement of cell size, Gross cellular composition of microbial cell, Growth – Factors affecting growth, Sporulation and spore germination in bacteria. Protoplasts formation. Induction and repression of enzymes.

Suggested Readings

Doelle HW. 1969. *Bacterial Metabolism*. Academic Press.

Gottschalk G. 1979. *Bacterial Metabolism*. Springer Verlag.

Moat AG. 1979. *Microbial Physiology*. John Wiley & Sons.

Sokatch JR. 1969. *Bacterial Physiology and Metabolism*. Academic Press.

MICRO 503

MICROBIAL GENETICS
(Pre-requisite Micro 501)

2+1

Objective

To acquaint the learners regarding molecular concepts of bacteria and viruses and impact of gene cloning on human welfare.

Theory

UNIT I

Prokaryotic, eukaryotic and viral genome. Replication of Eukaryotic, Prokaryotic and Viral DNA. Structure, classification and replication of plasmids.

UNIT II

Molecular basis of mutation. Biochemical genetics and gene mapping by recombination and complementation. Fine gene structure analysis. Fungal genetics.

UNIT III

Gene transfer in bacteria through transformation, conjugation and transduction; gene mapping by these processes. Transposable elements.

UNIT IV

Gene cloning and gene sequencing. Impact of gene cloning on human welfare. Regulation of gene expression. Recent advances in DNA repair and mutagenesis, Genetic basis of Cancer and cell death.

Practical

Inactivation of microorganisms by different mutagens. Production, isolation and characterization of mutants. Determination of mutation rate. Isolation, characterization and curing of plasmids. Transfer of plasmid by conjugation, electroporation. Tetrad and random spore analysis.

Suggested Readings

Birge EA. 1981. *Bacterial and Bacteriophage Genetics*. Springer Verlag.

Gardner JE, Simmons MJ & Snustad DP. 1991. *Principles of Genetics*.

John Wiley & Sons.

Lewin B. 1999. *Gene*. Vols. VI-IX. John Wiley & Sons.

Maloy A & Friedfelder D. 1994. *Microbial Genetics*. Narosa.

Scaife J, Leach D & Galizzi A 1985. *Genetics of Bacteria*. Academic Press.

William Hayes 1981. *Genetics of Bacteria*. Academic Press.

MICRO 504

SOIL MICROBIOLOGY

2+1

Objective

Objective of this course is to teach students regarding basics of microbiology related to soil including biogeochemical cycles, plant growth promoting rhizobacteria, microbial interactions in soil and other soil activities.

Theory

UNIT I

Soil biota, Soil microbial ecology, types of organisms in different soils; Soil microbial biomass; Microbial interactions: unculturable soil biota.

UNIT II

Microbiology and biochemistry of root-soil interface; phyllosphere, Biofertilizers, soil enzyme activities and their importance.

UNIT III

Microbial transformations of nitrogen, phosphorus, sulphur, iron and manganese in soil. Siderophores and antimicrobials. Biochemical composition and biodegradation of soil organic matter and crop residues.

UNIT IV

Biodegradation of pesticides, Organic wastes and their use for production of biogas and manures: Biotic factors in soil development.

Practical

Determination of soil microbial population; Soil microbial biomass; Decomposition studies in soil, Soil enzymes; Measurement of important soil microbial processes such as ammonification, nitrification. N₂ fixation, S oxidation, P solubilization and mineralization of other micro nutrients; Study of rhizosphere effect.

Suggested Readings

Martin Alexander 1977. *Soil Microbiology*. John Wiley.

Paul EA. 2007. *Soil Microbiology, Ecology and Biochemistry*. 3rd Ed. Academic Press.

Sylvia *et al.* 2005. *Principles and Applications of Soil Microbiology*. 2nd Ed. Pearson Edu.

Elsas JD, Trevors JT & Wellington EMH. 1997. *Modern Soil Microbiology*. Marcel Dekker.

MICRO 505

MICROBIAL BIOTECHNOLOGY
(Pre-requisite Micro 501)

2+1

Objective

To teach students about industrially useful microorganisms and use of fermentor for the production of various primary and secondary metabolites.

Theory

UNIT I

Introduction, scope and historical development; Isolation, screening and genetic improvement of industrially important microorganisms.

UNIT II

Types of fermentation systems; production of various primary and secondary metabolites, e.g. amino acids, organic acids, alcohols, enzymes, organic solvents, antibiotics, etc.

UNIT III

Process scale up steps: laboratory, pilot plant and industrial scales. Down stream processing; Over-production of metabolites; Bioreactor operations, process control.

UNIT IV

Fermented beverages; Production of single cell protein; Steroid transformation; Immobilization of cells/enzymes; Silage production; Waste water treatment.

UNIT V

Use of genetically-engineered microorganisms in biotechnology; Bioinsecticides, biofertilizers, etc. Microbiologically-produced food colours and flavours. Retting of flax.

Practical

Isolation and Maintenance of industrially important microorganisms, Improvement of industrially important microorganisms, Production of (industrial compounds such as) alcohol, beer, wine,

citric acid and lactic acid and recovery, Study of types of bio-reactors and their operation , Production of bacterial biofertilizers:, Production of algal biofertilizer, Visit to Biofertilizer industries

Suggested Readings

Cruger W & Cruger A. 2004. *Biotechnology - A Textbook of Industrial Microbiology*. 2nd Ed. Panima.

Ward OP. 1989. *Fermentation Biotechnology*. Prentice Hall.

Wiseman A. 1983. *Principles of Biotechnology*. Chapman & Hall.

MICRO 506

**FOOD AND DAIRY MICROBIOLOGY
(Pre-requisite, Micro 501)**

2+1

Objective

To familiarize the students with recent advances in food microbiology including fermented foods, dairy, food preservation, detection of foodborne diseases, their control measures.

Theory

UNIT I

Introduction and scope; Food Microbiology – A many faceted science; Interrelationship of food microbiology with other sciences; Perspectives on food safety and Food Biotechnology.

UNIT II

Factors of special significance in Food Microbiology – Principles influencing microbial growth in foods; Spores and their significance; Indicator organisms and Microbiological criteria; Microbial spoilage of foods- meat, milk, fruits, vegetables and their products; Food poisoning and food-borne pathogenic bacteria.

UNIT III

Food fermentation; Fermented dairy, vegetable, meat products; Preservatives and preservation methods – physical methods, chemical preservatives and natural antimicrobial compounds. Bacteriocins and their applications; Biologically based preservation systems and probiotic bacteria.

UNIT IV

Advanced techniques in detecting food-borne pathogens and toxins. Hurdle technology and Hazard analysis. Critical control point systems in controlling microbiological hazards in foods.

Practical

Statutory, recommended and supplementary tests for microbiological analysis of Baby foods, Microbiological analysis of canned foods, Microbiological analysis milk and dairy products, Microbiological analysis of eggs and meat, Microbiological analysis of vegetables, fruits and cereals, Microbiological analysis of surfaces and containers in a food processing unit and environment in a food processing area, Microbiological analysis of water, Visit to Food & Dairy industry

Suggested Readings

- Bibek Ray.1996. *Fundamentals of Food Microbiology*. CRC Press.
Frazier WC & Westhoff DC. 1991. *Food Microbiology*. 3rd Ed. Tata McGraw Hill.
George J Banwart. 1989. *Basic Food Microbiology*. AVI.
James M Jay. 1987. *Modern Food Microbiology*. CBS.
Peppler HJ & Perlman D.1979. *Microbial Technology*. 2nd Ed. Academic Press.

MICRO 507

BACTERIOPHAGES

1+1

Objective

To familiarize students about phages and phage- bacterial interactions.

Theory

UNIT I

Historical developments and classification of bacteriophages.

UNIT II

Physiology, biochemistry, enzymology and molecular biology of phagebacterial interactions.

UNIT III

Structure, functions and life cycles of different DNA, RNA, lytic and lysogenic phages.

UNIT IV

Phages in the development of molecular biology and genetic engineering.

Practical

Titration of phages and bacteria Absorption of phages, Preparation of phage stocks, Isolation of new phages and phage resistant bacteria, One step growth curve, phage bursts, Induction of lambda. Complementation of T4 *rII* mutants etc.

Suggested Readings

- Birge EA. 2000. *Bacterial and Bacteriophage Genetics*. Springer-Verlag.
Mathew CK. 1972. *Bacteriophage Biochemistry*. Am. Chemical Soc.
Mathew CK, Kutter EM, Mosig G & Berget P. 1988. *Bacteriophage T4*. Plenum Press.
Nancy T & Trempy J. 2004. *Fundamental Bacterial Genetics*. Blackwell.
Stent SG. 1963. *Molecular Biology of Bacterial Viruses*. WH Freeman.
Winkler J, Ruger W & Wackernagel W. 1979. *Bacterial, Phage and Molecular Genetics - An Experimental Course*. Narosa.
Winkler U & Ruhr W. 1984. *Bacteria, Phage and Molecular Genetics*. ALA.

MICRO 508

ENVIRONMENTAL MICROBIOLOGY (Pre-requisite Micro 502)

2+1

Objective

To teach and create awareness regarding environment, water, soil, air pollution and bioremediation.

Theory

UNIT I

Scope of environmental microbiology. An overview of microbial niches in global environment and microbial activities. Microbiology of air, outdoor and indoor environment in relation to human, animal and plant health and economic activities.

UNIT II

Microbiology of natural waters. Environmental pollution – Deleterious and beneficial role of microorganisms. Environmental microbiology in public health. Microorganism in extreme environments, Environmental determinants that govern extreme environment- Air water interface, extreme of pH, Temperature, Salinity, Hydrostatic pressure.

UNIT III

Microbial technology in pollution abatement, waste management and resource recovery in metal, petroleum and bioenergy fields. Biofuels. Global environmental problems

UNIT IV

Microbial upgradation of fossil fuels and coal gas. Microbial interaction in rumen and gastrointestinal tract. Biodeterioration and Bioremediation. Biodegradation and xenobiotic compounds

Practical

Analysis of natural waters, waste waters and organic waste in relation to water pollution assessment, pollution strength and resource quantification; Quality control tests, waste treatment and anaerobic digestion; Demonstration of waste water treatment processes such as activated sludge processes, biofilter and fluidized bed process. Visit to water / effluent treatment plants

Suggested Readings

Campbell R. 1983. *Microbial Ecology*. Blackwell.

Hawker LE & Linton AH. 1989. *Microorganisms Function, Form and Environment*. 2nd Ed. Edward Arnold.

Mitchell R. 1992. *Environmental Microbiology*. John Wiley & Sons.

Richards BN. 1987. *Microbes of Terrestrial Ecosystem*. Longman.

MICRO 509

PLANT- MICROBE INTERACTIONS

3+0

(Open for: Microbiology, Biotechnology & Molecular Biology, Genetics, Pl. Physiology, Biochemistry, Plant Breeding & Plant Pathology students; Pre-requisite Micro503/Equiv., Micro 504)

Objective

To familiarize the students with the biochemical and biophysical mechanisms, genetics, genomics, proteomics and advanced microscopy, spectroscopy of different interfaces of beneficial and pathogenic plant microbe interactions. Molecular analysis of relevant factors in the plant and microbes, and components that modulate plant-microbe interactions for soil and plant health for sustaining crop productivity.

Theory

UNIT I

Different interfaces of interactions - Plant-microbe, microbe-microbe, soil - microbe, soil-plant-microbe interactions leading to symbiotic (rhizobial and mycorrhizal), associative, endophytic and pathogenic interactions. Types of ecosystems: Concept and dynamics of ecosystem, Food chain and energy flow, Microbial communities in the soil. Community dynamics and population interactions employing DGGE, TGGE, T-RFLP.

UNIT II

Quorum-sensing in bacteria, flow of signals in response to different carbon or other substrates and how signals are recognized.

UNIT III

Methodology/resources to study plant-microbe interaction, recombinant inbred lines, biosensors, transcriptome profiling, metabolic profiling, genomics, proteomics and advanced microscopy, spectroscopy of different interfaces.

UNIT IV

Plant and microbial gene expression and signal exchange, global and specific regulators for different interactions. Molecular diversity of microbes, plants and their interactions including transgenic microbes and plants.

Suggested Readings

Kosuge T & Nester EW. 1989. *Plant-Microbe Interactions: Molecular and Genetic Perspectives*. Vols I-IV. McGraw Hill.

Verma DPS & Kohn TH. 1984. *Genes Involved in Microbe-Plant Interactions*. Springer Verlag. *Molecular Plant-Microbe Interactions*. Journal Published by APS.

MICRO 510

INDUSTRIAL MICROBIOLOGY

2+1

(Open for: Microbiology, Biotechnology, Biochemistry, Soil Science, Agronomy, Plant Pathology, Horticulture students; prerequisite Micro 504, Micro 506)

Objective

To expose the students to the commercial exploitation of microorganisms for production of useful products. Focus will be on understanding of the techniques involved and the application of microorganisms for agribusiness purpose.

Theory

UNIT I

Biofermentor; Production of wine, beer, lactic acid, acetic acid (vinegar), citric acid, antibiotics, enzymes, vitamins and single cell proteins. Biofuels: Production of ethanol, biogas and hydrogen production.

UNIT II

Brief introduction to bacterial, fungal and insect diseases, Types of chemicals/pesticides used for disease control. Vaccines. Bioagents and Biopesticides Biocontrol agents and their scope in control of plant diseases, nematodes and insect pests.

UNIT III

Bioplastics and biopolymers: Microorganisms involved in synthesis of biodegradable plastics, other pigments, Biosensors: Development of biosensors to detect food contamination and environment pollution.

UNIT IV

Biofertilizers, Genetic engineering of microbes for enhanced pesticide degradation Mechanisms of pesticide degradation by microbes. Biomining: Coal, mineral and gas formation, prospecting for deposits of crude, oil and gas, recovery of minerals from low-grade ores.

Practical

Production of industrial compounds such as alcohol, beer, citric acid, lactic acid and their recovery. Detection of food-borne pathogens, pesticide degradation, Demonstration of biogas production, Production of biocontrol agents, Visit to industries

Suggested Readings

Alexander M. 1977. *Soil Microbiology*. John Wiley.

Hawker LE & Linton AH. 1989. *Microorganisms Function, Form and Environment*. 2nd Ed. Edward Arnold.

James M Jaq 1987. *Modern Food Microbiology*. CBS.

Paul EA. 2007. *Soil Microbiology, Ecology and Biochemistry*. 3rd Ed Academic Press.

Stanbury PF & Whitaker A. 1987. *Principles of Fermentation Technology*. Pergamon Press.

Sylvia DM, Fuhrmann JJ, Hartlly PT & Zuberer D. 2005. *Principles and Applications of Soil Microbiology*. 2nd Ed. Pearson Prentice Hall Edu.

MICRO 511

BIOFERTILIZER TECHNOLOGY

1+1

Objective

To familiarize the students and farmers with mass scale production of different agriculturally important microorganisms which are being used as biofertilizers for maintaining the soil and plant health for sustaining crop productivity and their importance in organic farming.

Theory

UNIT I

Different agriculturally important beneficial microorganisms – free living, symbiotic (rhizobial, actinorhizal), associative and endophytic nitrogen fixers including cyanobacteria, taxonomic classification, nodule formation, competitiveness and quantification of N₂ fixed.

UNIT II

Different agriculturally important beneficial microorganisms – phosphate solubilizing bacteria and fungi, including mycorrhiza.

UNIT III

Different agriculturally important beneficial microorganisms – plant growth promoting rhizobacteria.

UNIT IV

Different agriculturally important beneficial microorganisms – Biocontrol microbial inoculants.

UNIT V

Different agriculturally important beneficial microorganisms for recycling of organic waste and composting, bioremediators and other related microbes.

UNIT VI

Different agriculturally important beneficial microorganisms - selection, establishment, competitiveness, crop productivity, soil & plant health, mass scale production and quality control of bio inoculants. Biofertilizer inoculation and microbial communities in the soil.

Practical

Isolations of symbiotic, asymbiotic, associative nitrogen fixating bacteria, Development and production of efficient microorganisms, Determination of beneficial properties in important bacteria to be used as biofertilizer, Nitrogen fixing activity, indole acetic acid (IAA), siderophore production etc, Bioinoculant production and quality control, Visit to industry

Suggested Readings

Alexander M. 1977. *Soil Microbiology*. John Wiley.

Bergerson FJ. 1980. *Methods for Evaluating Biological Nitrogen Fixation*.

John Wiley & Sons.

Sylvia DM, Fuhrmann JJ, Hartlly PT & Zuberer D. 2005. *Principles and Applications of Soil Microbiology*. 2nd Ed. Pearson Prentice Hall Edu.

van Elsas JD, Trevors JT & Wellington EMH. 1997. *Modern Soil Microbiology*. CRC Press.

MICRO 512

CYANOBACTERIAL AND ALGAL BIOTECHNOLOGY

2+0

Objective

To teach students about this upcoming fascinating field of microbes developed at a faster pace, mainly due to photoautotrophic nature of Cyanobacteria, their ability to survive under a variety of habitats and wide diversity of thallus structure and functions. Their importance for mankind is enormous including their role as biofertilizers, nutraceuticals, experimental models, dyes, biofuels and a variety of biochemicals. regarding structure, molecular evolution and properties of cyanobacteria and algae

Theory

UNIT I

Introduction to Cyanobacteria and algae. Definition, occurrence and distribution, thallus structure, reproduction, life cycles, origin and evolution of Cyanobacteria, molecular evolution; role of algae in evolution of land plants and horizontal transfer of genes.

UNIT II

Algal pigments, storage products, carbon metabolism, photosynthesis. Algal culturing and cultivation. Culture types, culture conditions, culture vessels, culture media, sterilization,

culture methods, synchronous cultures, photobioreactors, algal density and growth, seaweed cultivation.

UNIT III

Cyanobacterial and algal fuels, Fine chemicals (restriction enzymes etc) and nutraceuticals from algae; UV absorbing pigments Industrial products from macro algae - seaweed biotechnology, sustainable aquaculture.

Ecology of algae- distribution in soil and water; primary colonizers, carbon sequestration and cycling in soil and water. Cellular differentiation and nitrogen fixation, nitrogen metabolism.

UNIT IV

Algae in pollution - as pollution indicators, eutrophication agents and role in Bioremediation. Cyanobacterial and algal toxins, allelopathic interactions, Algae in global warming and environmental sustainability. Cyanobacteria and selected microalgae in agriculture – biofertilizers & algalization; soil conditioners; reclamation of problem soils.

Suggested Readings

- Ahluwalia AS. 2003. *Phycology: Principles, Processes and Applications*. Daya Publ.
- Barsanti L & Gualtieri P. 2006. *Algae: Anatomy, Biochemistry and Biotechnology*. Taylor & Francis, CRC Press.
- Carr NG & Whitton BA. 1982. *The Biology of Cyanobacteria*. Blackwell.
- Herrero A & Flores E. 2008. *The Cyanobacteria Molecular Biology, Genomics and Evolution*. Calster Academic Press
- Kumar HD. 2005. *Introductory Phycology*. East West Press.
- Linda E Graham & Lee W Wilcox. 2000. *Algae*. Prentice Hall.
- Robert A Andersen. 2005. *Algal Culturing Techniques*. Academic Press.
- Venkataraman LV & Becker EW. 1985. *Biotechnology and Utilization of Algae: the Indian Experience*. DST.

MICRO 601

ADVANCES IN FERMENTATION

2+1

Objective

To teach students regarding fermentation industry using industrially useful microorganisms including yeast technology.

Theory

UNIT I

An overview of fermentation - current status of fermentation industry. Fermentor design, high performance bioreactors, mass and energy transfer in bioreactors. Instrumentation and control in fermentors – on line measurements systems, computer application.

UNIT II

Media for microbial fermentation; Criteria in media formulation. An overview of downstream processing.

UNIT III

New strategies for isolation of industrially important microbes and their genetic manipulations; Microbial production of health care products. Antibiotic fermentation research; steroid transformation.

UNIT IV

Recent developments on production of primary and secondary metabolites, Treatment of biological wastes, microbial inoculants and enzymes for waste treatment.

UNIT V

Yeast technology – classification, genetics, strain improvement for brewing, baking and distilleries and topics of current interest in fermentations.

Practical

Industrially important microbes and their genetic manipulations, Fermentation by improved strains of yeast for production of alcohol and beer, Microbial production of important antibiotics, enzymes and organic acids, Bioremediation of industrial effluents

Suggested Readings

Peppler HJ & Perlman D. 1979. *Microbial Technology*. 2nd Ed. Academic Press.

Reed G. 1987. *Presscott & Dunn's Industrial Microbiology*. 4th Ed. CBS.

Stanbury PF & Whitaker A. 1987. *Principles of Fermentation Technology*. Pergamon Press.

Wiseman A. 1983. *Principles of Biotechnology*. Chapman & Hall.

MICRO 602

**ADVANCED MICROBIAL PHYSIOLOGY
(Pre-requisite Micro 502)**

2+0

Objective

To acquaint students with current topics in molecular microbiology

Theory

UNIT I

Origin, evolution, structure, function and molecular aspects of various cell components.

UNIT II

Differentiation in bacteria, slime molds, yeasts.

UNIT III

Molecular biology of bioluminescence, bacterial virulence. Heat shock response. Extracellular protein secretion in bacteria.

UNIT IV

Topics of current interest in molecular microbiology.

Suggested Readings

Selected articles from journals.

MICRO 603

REGULATION OF MICROBIAL BIOSYNTHESIS
(Pre-requisite Micro 502, Micro 503)

2+0

Objective

Course imparts thorough knowledge about the synthesis of biomolecules in microorganisms by various pathways and their regulation.

Theory

UNIT I

Regulation of initiation, termination and anti-termination of transcription. Global regulation and differentiation by sigma factor. Regulatory controls in bacteria - inducible and biosynthetic pathways.

UNIT II

Ribosomal RNA and ribosomal proteins regulation under stress condition. Specific regulatory systems; SOS regulatory control; Antisense RNA regulation of gene expression.

UNIT III

Oxidative stress control. Fermentative and respiratory regulatory pathways. Regulation of cell cycle. Lytic and lysogenic cascade.

UNIT IV

Global nitrogen control and regulation of nitrogen fixation and other recent topics of regulatory systems of current interest.

Suggested Readings

Selected articles from journals.

MICRO 604

CURRENT TOPICS IN SOIL MICROBIOLOGY
(Pre-requisite Micro 504)

2+0

Objective

To make students learn the latest trends in soil microbiology like diversity, biological control and bioremediation.

Theory

UNIT I

Molecular ecology and biodiversity of soil microorganisms; Survival and dispersal of microorganisms.

UNIT II

Microbial successions and transformation of organic matter; Role of microorganisms in soil fertility.

UNIT III

Bioremediation of polluted soils; Biological control.

UNIT IV

Other topics of current interest.

Suggested Readings

Selected articles from journals.

List of Journals

Advances in Microbial Physiology
Annual Review of Genetics/Biochemistry
Annual Review of Microbiology
Applied and Environmental Microbiology
Biology and Fertility Soils
Indian Journal of Microbiology
Journal of Bacteriology
Journal of Basic Microbiology
Microbiology and Molecular Biology Reviews
Nature/Science/EMBO Journal
Reviews in Microbiology and Biotechnology
Soil Biology and Biochemistry
Trends in Biotechnology
Trends in Microbiology
Trends in Plant Sciences

e-Resources

Books

<http://www.aw-bc.com/microplace/>
<http://www.personal.psu.edu/jel5/micro/index.htm>
<http://microbiology.ucsc.edu/>

Details of sites related to Microbiology

<http://www.suite101.com/links.cfm/microbiology>
<http://www.microbeworld.org/resources/links.aspx>
<http://www.asm.org/>
<http://www.microbiologyworld.com/>
<http://www.sciencemag.org/cgi/collection>
<http://www.latrobe.edu.au/microbiology/links>
www.uwstout.edu/lib/subjects/microbi
<http://www.aemtek.com>

Journal related to Microbiology

<http://www.fems-microbiology.org/website/nl/default.asp>

<http://www.blackwellpublishing.com/journal>

<http://www.springer.com/>

<http://www.e-journals.org/microbiology/>

<http://pubs.nrc-cnrc.gc.ca/>

<http://www.elsevier.com/>

<http://www.academicjournals.org/ajmr/>

<http://www.horizonpress.com/gateway/journals.html>

<http://www.scielo.br/bjm>

<http://www.jmb.or.kr/>

Latest in microbiology- Microbiology News

<http://microbiologybytes.wordpress.com/>

<http://www.topix.net/science/microbiolog>

Suggested Broad Topics for Master's and Doctoral Research

Molecular Microbiology

Microbial diversity

Meta genomics

Improvement of beneficial microorganisms

(Nitrogen fixers, Phosphate solubilizers etc.)

Environmental Microbiology

Biocontrol

PGPR, Termite control, Pathogenic fungi control

Biofuels

Biogas, alcohol production

Bioremediation

Waste management, Bioremediation of industrial effluents and

agrochemicals

Composting

Microbial Biotechnology

Biofertilizers

(Nitrogen fixers, Phosphate solubilizers, PGPR, BGA, composting etc)

Secondary metabolites including industrially important enzymes, amino acids

Citric acid and lactic acid fermentations

Food Microbiology

Improvement and industrial exploitation of microorganisms

Fermented foods