

## Ph.D. Microbiology Syllabus

CODE	COURSE TITLE	CREDITS	SEM
MICRO 601*	Improvement in fermentation Technology	2+1	I <sup>st</sup>
MICRO 602	Microbial physiology and regulation	2+0	II <sup>nd</sup>
MICRO 603*	Recent development in soil microbiology	2+0	II <sup>nd</sup>
MICRO 604	Recent approaches in environmental microbiology	2+0	I <sup>st</sup>
MICRO 605*	Plant microbe interactions	2+1	I <sup>st</sup>
MICRO 691	Doctoral seminar I	1+0	
MICRO 692	Doctoral seminar II	1+0	
MICRO 699	Doctoral Research	75	

\*Core Courses

### MICRO:601\* IMPROVEMENTS IN FERMENTATION TECHNOLOGY

**Credit: 2+1**

#### BLOCK 1: RISE OF FERMENTATION TECHNOLOGY

##### Unit 1: Development in Fermentation

Definition of fermentation – rise of fermentation technology –current trends in fermentation industry – scope and importance of fermentation technology.

##### Unit 2: Types of fermenters

Continuous, batch and fed batch culture –anaerobic fermentation - range of fermentation process – microbial growth cycle – diauxic growth – growth kinetics – substrate uptake kinetics (Jacob and Monod) - primary and secondary metabolites – future prospects of fermentation microbiology

#### BLOCK 2: FERMENTER

##### Unit 1: Components of fermenter and use

Peripheral parts and accessories – alternative vessel designs containment in fermentation fermenter preparation and use - aeration and agitation instrumentation and control biosensors in monitoring – computer applications in fermentation technology

#### BLOCK 3: FERMENTATION PROCESS.

##### Unit 1: Types of Fermentation

Solid state and submerged fermentation acidic/alcoholic fermentation - recovery of product effluent treatment ,Economics of fermentation

#### BLOCK 4: RECOMBINANT STRATEGIES FOLLOWED

##### Unit 1: Strategies for isolation of industrially important microbes

New strategies for isolation of industrially important microbes and their genetic manipulations; Antibiotic fermentation research; steroid transformation; Yeast technology classification, genetics, strain improvement for brewing, baking and distilleries

#### PRACTICALS

1. Studying the various components of fermenter
2. exposure to different types of fermenter
3. sterilization and operating procedures
4. designing the production medium

5. isolation and purification of industrially important microbes
6. Genetic manipulations in microbes
7. Fermentation by improved strains of yeast for production of alcohol
8. microbial production of enzymes by solid state fermentation
9. Microbial production of important antibiotics
10. Bioremediation of industrial effluents

**MICRO 602 Title: MICROBIAL PHYSIOLOGY AND REGULATION Credit: 2+0**

**BLOCK1: HISTORICAL EVALUATION OF MICROBIAL PHYSIOLOGY**

Unit 1: Molecular aspects of various cell component

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

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

**BLOCK 2: REGULATION AND PATHWAYS**

Unit 1: Regulatory Pathways

Regulation of initiation, termination and anti-termination of transcription. Global regulation and differentiation by sigma factor. Regulatory controls in bacteria - inducible and biosynthetic pathways. Oxidative stress control. Fermentative and respiratory regulatory pathways.

Unit 2: Regulatory control

Ribosomal RNA and ribosomal proteins regulation under stress condition. Specific regulatory systems; SOS regulatory control; Antisense RNA regulation of gene expression. Biosynthesis of micromolecules (Nucleotides and Aminoacids) macromolecules (DNA, RNA, Proteins) Global nitrogen control and regulation of nitrogen fixation

Unit 3: Current topics

Topics of current interest in Molecular microbiology and regulatory systems.

**MICRO 603\* Title: RECENT DEVELOPMENTS IN SOIL MICROBIOLOGY Credit: 2+0**

Unit 1: Ecology and microorganisms' diversity

Molecular ecology and biodiversity of soil microorganisms; Survival and dispersal of microorganisms. Interaction between agricultural chemicals, pollutants and soil microorganism

Unit 2: Role of microorganisms in soil

successions and transformation of organic matter; Role of microorganisms in soil fertility. Soil health and quality: Microbial indicators

Unit 3: Bioremediation

Bioremediation of polluted soils; Biological control. Other topics of current interest.

## **MICRO 604 RECENT APPROACHES IN ENVIRONMENTAL MICROBIOLOGY Credit: 2+0**

### **BLOCK 1: RECENT ENVIRONMENTAL ISSUE**

Unit 1: Basic concept and environmental issues

Types of environmental pollution; problems arising from high-input agricultural residues. Air and water pollution.

Unit 2: Methodology of environmental management

Waste water treatment -physical, chemical, biological and microbial processes; need for water and natural resource.

Unit 3: Microbial waste treatment

Microbiology and use of micro-organisms in waste treatment; biodegradation; degradation of Xenobiotic, surfactants; bioremediation of soil & water contaminated with oils, pesticides & toxic chemicals, detergents etc.; aerobic processes (activated sludge, oxidation ditches, trickling filter, rotating drums, etc.); anaerobic processes: digestion, filtration, etc.

### **BLOCK 2: ENERGY HARNESSING FROM ORGANIC WASTE**

Unit 1: Pollution through conventional fuel

Conventional fuels and their environmental impact.

Unit 2: Renewable sources of energy.

Energy from solid waste;; biogas; land filling, microbial hydrogen production; use of agro175 industrial waste, agricultural waste for sugar to alcohol; gasohol; biodegradation of lignin and cellulose; biopesticides; biofertilizers; composting; vermiculture, etc.

### **BLOCK 3: TREATMENT OF WASTE FOR SAFE DISPOSAL**

Unit 1: Disposal of domestic and industrial wastes.

Treatment schemes of domestic waste and industrial effluents; food, feed and energy from solid waste; bioleaching; enrichment of ores by micro-organisms.

Unit 2: Global environmental problems

Ozone depletion, UV-B, greenhouse effects, and acid rain; biodiversity and its conservation; Microbial and biotechnological approaches for the management of environmental problems.

## **MICRO 605\* PLANT MICROBE INTERACTIONS Credit: 1+1**

### **BLOCK 1: TYPES OF ECOSYSTEM AND MICROBIAL INTERACTION**

Unit 1: Different interfaces of interactions

Plant-microbe, microbe-microbe, soil- microbe, soil-plant-microbe interactions leading to symbiotic (rhizobial and mycorrhizal, Azolla-Anabaena), associative, endophytic and pathogenic interactions.

Unit 2: Ecosystem- Concept and Dynamics

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.

### **BLOCK 2: SIGNALING AND INTERACTION AMONG MICROBES**

Unit 1: Microbial interaction

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

## **BLOCK 3: GENOMIC AND PROTEOMIC STUDY IN PLANT MICROBE INTERACTION**

### **Unit 1: Methodology/resources in plant-microbe interaction**

Methodology/resources to study plant-microbe interaction, biosensors, transcriptome profiling, metabolic profiling, genomics, and proteomics Induced systemic resistance against pathogens and tolerance against abiotic stress: Molecular basis; Molecular diversity of microbes, plants and their interactions including transgenic microbes and plants

### **PRACTICALS**

1. Phylochip based microbial community analyses-
2. Endophytic and phyllosphere microbial community
3. PCR-DGGE-Rhizosecretion
4. secretome -FT-IR, HPLC
5. Multifunctional protein identification and characteriation-2DE, MALDI-TOF.
6. Examination of mycorrhizal infection in roots of different plants.
7. Characterization of PGPR; Quantification of siderophores, HCN and IAA