

## Course Structure of Ph. D. in Agricultural Microbiology

Course structure is prepared as per the ICAR-PG syllabus 2009

The same syllabus is followed in University of Agricultural Sciences, Dharwad

Sl No	Course No	Title	Credit hours
5) 1	Micro 601**	Advances in fermentation	2+1
5) 2	Micro 602**	Advanced Microbial Physiology	2+0
3	Micro 603**	Regulation of Microbial Biosynthesis,	2+0
5) 4	Micro 604**	Current Topics in Soil Microbiology	2+0
5) 5	Micro 605**	Plant Microbe Interactions	3+0
5) 6	Micro 606**@	Advances in Microbial Biotechnology	3+0
<b>Total</b>			<b>15</b>

\*\*compulsory for doctoral program

@ shared with biotechnology

### Minimum credit requirements for Doctoral Programme

Major : 15

Minor : 8

Supporting : 5

Seminar : 2

Research : 45

Total credits : 75

## **COURSES AND SYLLABUS FOR Ph. D PROGRAM**

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. Fermenter design, High performance bioreactor, Mass and energy transfer in bioreactors. Instrumentation and control in fermenters-online measurements systems, Computer applications.

### 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 waste, 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 fermentation.

## PRACTICAL

Industrially important microbes and their genetic manipulation, 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 Reading

1. Pepler, H.J. and Pearlman, D. 1979. Microbial Technology. 2<sup>nd</sup> Ed. Academic Press
2. Reed, G. 1987. Prescott & Dunn's Industrial Microbiology. 4<sup>th</sup> Ed. CBS
3. Stanbury, P.F. and Whittakar, A. 1987. Principles of Fermentation Technology. Pergamon Press.
4. Wiseman, A. 1983. Principles of Biotechnology. Chapman and Hall.

**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 moulds, 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

**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      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

### **Micro 605      PLANT MICROBE INTERACTIONS      3+0**

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

Unit IV

Plant and microbe 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

1. Kosuge, T. and Nester, E.W. 1989. Plant microbe interactions; molecular and genetic perspectives. Vols. I-IV. McGraw Hill.
2. Verma, D.P.S. and Kohn, T.H. 1984. Genes involved in microbe-plant interactions. Springer Verlag. Molecular Plant Microbe interactions. Journal published by APS

## **Micro 606 ADVANCES IN MICROBIAL BIOTECHNOLOGY 3+0**

**Objective**

To discuss specialized topics about industrially important microorganisms

**Theory**

#### Unit I

Fermentative metabolism and development of bioprocessing technology, processing and production of recombinant products; isolation, preservation and improvement of industrially important microorganisms

#### Unit II

Immobilization of enzymes and cells; batch, plug flow and chemostat cultures; computer simulations; fed batch and mixed cultures; scale up principles; downstream processing etc.

#### Unit III

Current advances in production of antibiotics, vaccines and biocides; steroid transformation, bioreactors, bioprocess engineering; production of non-microbial origin products by genetically engineered microorganisms

#### Unit IV

Concept of probiotics and applications of new tools of Biotechnology for quality feed/ food production; microorganisms and proteins used in probiotics; lactic acid bacteria as live vaccines; factors affecting delignification; bioconversion of substrates, anti-nutritional factors present in feeds; microbial detoxification of aflatoxins; single cell proteins, bioinsecticides; biofertilizers; recent advances in Microbial Biotechnology

#### Suggested Readings

Specific journals and published references