



**Department of Plant Pathology and
Agricultural Microbiology
Mahatma Phule Krishi Vidyapeeth
Rahuri-413 722, Dist. Ahmednagar (MS)**



Doctoral Programme in Agricultural Microbiology

Course Layout

Minimum Credit Requirements

Sr. No.	Subject	Minimum credit (s)
1.	Major	15
2.	Minor	08
3.	Supporting	05
4.	Seminar	02
5.	Research	45
6.	Total Credits	30+45=75
7.	Compulsory Non Credit Courses	06

Sr. No.	Course Number	Course Title	Credits
Agricultural Microbiology			
A) Major subjects (Min. 15 credits)			
I Semester			
1.	MICRO 509	Plant Microbe Interaction	3+0=3
2.	MICRO 510	Industrial Microbiology	2+1=3
3.	MICRO 601	Advances in Fermentation	2+1=3
II Semester			
4.	MICRO 602	Advanced Microbial Physiology	2+0=2
5.	MICRO 603	Regulation of Microbial Biosynthesis	2+0=2
6.	MICRO 604	Current Topics in Soil Microbiology	2+0=2
Total			13+2=15

B) Minor Subjects (Min. 08 credits)			
I Semester			
1.	BIOCHEM 601	Advanced Enzymology	2+0=2
2.	BIOCHEM 602	Advanced Molecular Biology	3+0=3
II Semester			
3.	BIOCHEM 603	Biochemistry of Biotic and Abiotic Stresses	3+0=3
Total			8+0=08
C) Supporting Subjects (Min. 02 credits)			
I Semester			
1.	BIOCHEM 607	Advanced Techniques in Biochemistry	0+2=2
II Semester			
2.	MBB 512	Immunology and Molecular Diagnostics	2+1=3
Total			2+3=05
D) Seminar (Min. 02 credits)			
III Semester			
1.	MICRO 691	Doctoral Seminar I	1+0=1
IV Semester			
2.	MICRO 692	Doctoral Seminar II	1+0=1
Total			1+1=02
E) Doctoral Research (Min. 45 credits)			
1.		Doctoral Research	45
F) Non Credit Compulsory Courses			
I Semester			
1.	PGS 501	Library and Information Services	0+1=1
2.	PGS 504	Basic Concepts in Laboratory Techniques	0+1=1
II Semester			
3.	PGS-502	Technical writing and Communication skills	0+1=1
4.	PGS 503	Intellectual Property and its Management in Agriculture	1+0=1
III Semester			
5.	PGS 505	Agricultural Research Ethics and Rural Development Programmes	1+0=1
6.	PGS 506	Disaster Management	1+0=1
Total			3+3=06

Course Contents

A) Major Subject:-

I Semester:-

i) Plant Microbe Interactions

Theory Syllabus:

Unit-I: Different interfaces of interactions - Plant-microbe, microbe-microbe, soilmicrobe, soil-plant-microbe interactions leading to symbiotic (rhizobial, algal, actinomycetous 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.

Text book and Reference books:

Kosuge, T. & Nester, E.W. 1989. Plant-Microbe Interactions: Molecular and Genetic Perspectives. Vols I-IV. McGraw Hill., New Delhi

Verma, D.P.S. & Kohn, T.H. 1984. Genes Involved in Microbe-Plant Interactions. SpringerVerlag., New York

Molecular Plant-Microbe Interactions. Journal Published by APS., New York

ii) Industrial Microbiology

Theory Syllabus:

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
Production of vaccines, amino acids. Brewing and baking. Microbial fermentation of Alcohol. Fermented milk product and cheese. Fermented foods from cereals, legumes and oilseed cakes, pickles and sauerkraut. Production of growth promoting substances
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, Biodiversity: Structural, biochemical and molecular systematics, Numerical taxonomy. Magnitude and distribution of biodiversity
UNIT IV
Biofertilizers, Genetic engineering of microbes for enhanced pesticides degradation Mechanisms of pesticides 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 Syllabus:

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

Text book and Reference books

Alexander M. 1977. *Soil Microbiology*. John Wiley & sons, New York

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

James M. Jay. 1987. *Modern Food Microbiology*. CBS, New York

Paul, E.A. 2007. *Soil Microbiology. Ecology and Biochemistry*. 3rd Ed Academic Press., London

Stanbury, P.F. & Whitaker, A. 1987. *Principles of Fermentation Technology*. Pergamon Press, Tokyo

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

iii) Advances in Fermentation

Theory Syllabus:

UNIT I
An overview of fermentation – current status of fermentation industry. Fermentation 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 Syllabus:

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.

Text book and Reference books

Peppler, H.J. & Perlman, D. 1979. *Microbiology Technology*. 2nd Ed. Academic Press., New York

Prescott, S.C. and Dunn, C.G. 2007. *Industrial Microbiology*, AGRBIOS (India), Jodhpur
Stanbury, P.F. & Whitaker. A. 1987. *Principles of Fermentation Technology*. Programon Press, Tokyo

Wiseman, A. 1983. *Principles of Biotechnology*. Chapman & Hall, New York.

Semester II

iv) Advanced Microbial Physiology

Theory Syllabus:
UNIT I
Origins, 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.

Text book and Reference books:

Alexopoulos, C.J., Mims, C.W., and Blackwell, M. 1996 *Introductory Mycology* Fourth Edition, John Wiley & Sons, INC, Singapore

Doelle, H.W. 1969. *Bacterial metabolism*. Academic Press, New York

Moat A.G. 1979. *Microbial Physiology*. John Wiley & Sons, New York

Pelczar, Chan and Krieg. 1997. Microbiology. Mc-Graw Hill Publication, New York.

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

Ram Reddy, S. & S.M. Reddy. 2005. *Microbial Physiology*, Scientific Publishers (India), Jodhpur.

v) Regulation of Microbial Biosynthesis

Theory Syllabus:

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 system; 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.

Text book and Reference books:

George M. Malancinski and David Freifelder, 1998 Essentials of Molecular Biology, Jones and Bartlett Publishers, 3rd edition., London.

Ram Reddy, S. & S.M. Reddy. 2005. Microbial Physiology, Scientific Publishers (India), Jodhapur.

Sullia, S.B. and Shantharam, S. 2005. General Microbiology., Oxford and IBH Publishing Co., New Delhi.

Stickberger, 1985, Genetics, Macmillan Publishing Co., 3rd Edition, New York.

vi) Current Topics in Soil Microbiology**Theory Syllabus:**

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.
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UNIT IV: Other topics of current interest.

Text book and Reference books:

Selected articles from journals.