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

Master's Programme in Agricultural Microbiology

Course Layout

Minimum Credit Requirements

Sr. No.	Subject	Minimum credit (s)
1.	Major	20
2.	Minor	09
3.	Supporting	06
4.	Seminar	01
5.	Research	20
6.	Total Credits	36+20=56
7.	Compulsory Non Credit Courses	06

Sr. No.	Course Number	Course Title	Credits
Agricultural Microbiology			
A) Major subjects (Min. 20 credits)			
I Semester			
1.	MICRO 501	Principles of Microbiology	3+1=4
2.	MICRO 502	Microbial Physiology and Metabolism	3+1=4
3.	MICRO 503	Microbial Genetics	2+1=3
II Semester			
4.	MICRO 504	Soil Microbiology	2+1=3
5.	MICRO 505	Microbial Biotechnology	2+1=3
III Semester			
6.	MICRO 506	Food and Dairy Microbiology	2+1=3
		Total	14+6=20

B) Minor Subjects (Min. 09 credits)			
I Semester			
1.	**BIOCHEM 501**	**Basic Biochemistry**	**2+1=3**
II Semester			
2.	**BIOCHEM 505**	**Techniques in Biochemistry**	**1+2=3**
3.	**SOILS 506**	**Soil Biology and Biochemistry**	**2+1=3**
		Total	**5+4=09**
C) Supporting Subjects (Min. 06 credits)			
II Semester			
1.	**STAT 507**	**Design of Experiments for Plant Protection**	**2+1=3**
III Semester			
2.	**BIOCHEM 510**	**Carbon and Nitrogen Metabolism**	**2+1=3**
		Total	**4+2=06**
D) Seminar (Min.01 credits)			
IV Semester			
1.	**MICRO 591**	**Master's Seminar**	**1+0=1**
		Total	**1+0=01**
E) Master's Research (Min. 20 credits)			
1.		**Master's Research**	**20**
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 506**	**Disaster Management**	**1+0=1**
6.	**PGS 505**	**Agricultural Research Ethics and Rural Development Programmes**	**1+0=1**
		Total	**3+3=06**

Course Contents

A) Major Subject:-
I Semester:-
i) Principles of Microbiology
Theory Syllabus –
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, Tanericutes and Mendosicutes.
UNIT IV
Viruses- morphology, classification and replication of plant, animal and bacterial viruses. Purification methods of viruses. Immune response – specific and non- specific resistance. Normal microflora of human body. Some common bacterial and viral diseases of human and animals.

Practical Syllabus: `

Methods of isolation, purification and maintenance of microorganisms from different environments (air, water, soil, milk and food).Enrichment culture technique – isolation of asymbiotic, symbiotic nitrogen fixing bacteria. Isolation of photosynthetic bacteria.Use of selective media. Antibiotic resistance and isolation of antibiotic producing microorganisms. Morphological, physiological and biochemical characterization of bacteria.

Text Book and Reference books:

Brock T.D. 1961. *Milestones in Microbiology* . Infinity Books.

Pelczar M.J., Chan E.C.S. and Kreig N.R. 1997. *Microbiology : Concepts and Application*. Tata McGraw Hill, New Delhi

Stainier R.Y., Ingraham J.L., Wheelis M.L. & Painter P.R. 2003.*General Microbiology*. Mac Milla.

Tauro P., Kapoor K.K. and Yadav K.S. 1996.*Introduction to Microbiology*. Wiley Eastern.

ii) Microbial Physiology and Metabolism

Theory Syllabus:

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: Nutritional mode and groups of microorganisms. Important metabolic patterns in photoautotrophs, photoheterotrophs, chemoautotrophs and chemoheterotrophs.

Practical Syllabus:

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.

Text book and Reference books:

Doelle H.W. 1969. Bacterial Metabolism. Academic Press, New York
Gottschalk G. 1979. Bacterial Metabolism. Springer Verlag, New York
Moat A.G. 1979. Microbial Physiology. John Wiley & Sons, New York
Pelczar, Chan and Krieg. 1997. Microbiology. Mc-Graw Hill Publ. , New York
Sokatch J.R. 1969. Bacterial Physiology and Metabolism. Academic Press, New York
Stanier, R.Y., Adelberg, E.A. and Ingraham, J. 1985. General Microbiology. Macmillan Publ. Ltd., London.

iii) **Microbial Genetics**
Theory Syllabus:
UNIT I
Procaryotic.eucaryotic 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 VI
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 Syllabus:

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.

Text book and Reference books:

Birge E.A. 1981. *Bacterial and Bacteriophage Genetics*. Springer verlag, New York
Gardner J. E, Simmons M.J. & Snustad D. P. 1991. Principles of Genetics. John Wiley & Sons., New York
Lewin, B. 1999.*Gene*. Vols. VI-IX. John wiley&Sons.,New York
Malory, A.andFriedfelder, D. 1994. *Microbial genetics*.Narosa., New Delhi
Scaofe, J., Leach, D. &Galizzi, A. 1985. *Genetics of Bacteria*. Academic Press., London
William Hayes 1981. *Genetics of Bacteria*.Academic Press., London.

Semester II

iv) Soil Microbiology

Theory Syllabus:

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, carbon, sulphur, iron and manganese in soil. Siderophores and antimicrobials. Biochemical composition and biodegradation of soil organic matter and crop residues.

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

Practical Syllabus:

Determination of soil microbial population; Soil microbial biomass; Decomposition studies in soil, Soil enzymes; Measurement of important soil microbial processes such as ammonification, nitrification. N_2 fixation, S oxidation, P solubilization and mineralization of other micro nutrients; Studies on microbial interactions in soil, Study of rhizosphere effect.

Text books and Reference books:

Cruger, W. & Cruger, A. 2004, Biotechnology – A Textbook of Industrial Microbiology, 2nd Ed. Panima, New York
Ward, O.P. 1989, Fermentation Biotechnology. Prentice Hall, New Delhi
Wiseman, A. 1983. Principles of Biotechnology. Chapman & Hall, New York

V) Microbial Biotechnology

Theory Syllabus:

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, organic solvents, antibiotics, etc.
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 Syllabus:

Isolation of industrially important microorganisms, their maintenance and improvement. Production of industrial compounds such as alcohol, beer, citric acid, lactic acid and their recovery; Study of bio-reactors and their operation; Production of biofertilizers.

Text books and Reference books:

Cruger, W. &Cruger, A. 2004, *Biotechnology – A Textbook of Industrial Microbilogy*, 2nd Ed. Panima, New York
Ward, O.P. 1989. *Fermentation Biotechnology*. Prentice Hall, New Delhi
Wiseman, A. 1983. *Principles of Biotechnology*, Chapman & Hall, New York

Semester III

Vi) Food and Dairy Microbiology
Theory Syllabus:
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; Preservative 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 Syllabus:

Statutory, recommended and supplementary tests for microbiological analysis of various foods: Baby foods, canned foods, milk and dairy products, eggs, meat, vegetables, fruits, cereals, surfaces, containers and water.

Text book and Reference books:

Bibek Rey. 1996. Fundamentals of Food Microbiology. CRC Press, London

Frazier, W.C. & Westhoff, D.C. 1991. Food Microbiology. 3rd Ed. Tata McGraw Hill, New Delhi

George J. Banwart. 1989. Basic Food Microbiology. AVI., Tokyo

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

Pepper, H.J. & Perlman, D. 1979. Microbial Technology. 2nd Ed Academic Press, New York.