Learning Outcomes	1. Comprehend the mechanisms of immunological responses. 2. Apply the principles of cellular ontogeny and the gene rearrangement to understand the novel and complex immune system.	

Programme: M.Sc. (Microbiology)
Course Code: MIPE-402
Title of the Course: IMMUNOLOGY [P]
Number of Credits: 1, Practical
Contact hours: 30
Effective from Academic Year: 2022-23

Prerequisites	Basic knowledge of pathogens, haematology and principles of immunology.	
Objective:	Hands-on practice for various techniques used in immunology.	
Content:		**(30)**
1.	Haemagglutination: Blood grouping - ABO and Rh systems	
2.	Immunodiffusion slide technique	
3.	Agglutination tests for *Salmonella*-antigens	
4.	Complement fixation test	
5.	C-reactive protein determination	
6.	ELISA	
7.	Rapid tests – Malaria antigens Pv/Pf, IgM/IgG antibodies for Dengue, Hepatitis HBsAg	
8.	Rheumatoid Arthritis Factor determination	
Pedagogy:	Hands-on experiments in the laboratory, video, online data	
References/ Readings	As given under Theory Course MITE-402	
Learning Outcomes	Apply techniques in immuno-diagnosis.	

Programme: M.Sc. (Microbiology)
Course Code: MITE-403
Title of the Course: AGRICULTURE MICROBIOLOGY [T]
Number of Credits: 3, Theory
Contact hours: 45
Effective from Academic Year: 2022-23

Prerequisites	It is assumed that the students have knowledge about microorganisms and their diversity.	
Objective:	The course deal with the information about Inter-relationship of soil and microorganisms, different groups of beneficial microorganisms in agriculture, microbes as biofertilizer, plant pathogen and biocontrol agent.	
Content:		
1.	**Soil Microbiology**	**(15)**

1.1	**Microbial ecology:** Terrestrial Ecosystem, Pyramids and Econiches.	
1.2	**Soil Biogeochemistry**	
A.	Types of soil, soil Profile, Physico-Chemical (abiotic) and biotic characteristics.	
B.	Factors influencing microbial survival and establishment of inoculants.	
C.	Significance of microbial metabolism/enzymes on soil chemistry (nutrient cycling) & humus formation (humic and fulvic acids).	
1.3	**Plant and soil Microbiology:** Microbiology of the above and below ground parts of the plant (Phytosphere; Rhizosphere and Rhizoplane Microflora, phyllosphere, spermosphere)	
2.	**Plant-Microbe interactions (beneficial)**	**(15)**
A.	Plant growth promoting bacteria as biofertilizers Direct Mechanisms: Nutrient acquisition (nitrogen fixation, phosphate, Zinc, Potassium mobilization, siderophores, plant growth promoting hormones-Auxins, ACC Deaminase) Indirect Mechanisms: ISR, disease suppression	
B.	Mycorrhiza – Ectomycorrhiza, Endomycorrhiza, VAM structure & significance.	
C.	Nitrogen Fixing Microbes – Free living nitrogen (*Azotobacter, Azospirillum*), associative (Cyanobacteria, *Anabaena azollae)* and symbiotic (*Frankia*, *Rhizobium)*	
D.	Biochemistry and Genetics of Nitrogen fixation with reference to symbiotic and non symbiotic nitrogen fixers Significance of *nif* H, D, K, A, L, nod, nodulin and fix genes in the process of microbial nitrogen fixation.	
E.	Manure and compost as a soil amendment.	
G.	Microbial Pesticides-Biocontrol agents for agriculturally important crop plants-Development and their significance; Source Organisms: Bacteria-*Bacillus thuringiensis*, Bt based commercial products, other Bacilli producing pesticides; Fungi—*Beauveria bassiana*, *Metarhizium anisopliae*, *Trichoderma,* Viruses- Baculoviruses for insect pest control.	
3.	**Plant-Microbe interactions (Harmful)**	**(15)**
A.	Plant Pathogens and Genetic basis of pathogenesis, symptoms and plant defense response	
	Causative agents, pathogenesis symptoms, control of common bacterial pathogens, fungal, algal, viral, nematodes.	
B.	Plant Defense Response	
(i)	Phytoalexins and their induction.	
(ii)	Plant defense responses or mechanisms of control (anatomical changes and biochemical synthesis of toxins, alkaloids and other biocontrol molecules).	
C.	Other means of pathogen control.	
(i)	Application of Viral proteins in controlling viral diseases.	
(ii)	Antisense RNA technology in disease control.	

(iii)	Mycoviruses acting against fungal plant pathogens.	
(iv)	Integrated pest management, post harvest management, agri-entrepreneurship development (steps for starting small industry)	
Pedagogy:	Lectures/tutorials/assignments	
References/ Readings	Agrios G.N. Plant Pathology. Academic Press, San Diego	
(Latest edition)	Alexander, M., Introduction to Soil Microbiology, Wiley.	
	Bilgrami K. S. (1987) Plant Microbe Interactions, Proceedings of Focal Theme Symposium, Indian Science Congress Association, Narendra Publishing House.	
	Carr, N. G. and Whitton, B. A., The Biology of Blue-green algae, University of California Press.	
	Dadarwal, K. R., Biotechnological Approaches in Soil microorganisms for sustainable crop production, Scientific Publishers.	
	Kumar, H. D., Modern Concepts of Microbiology, Vikas Publishing House Pvt. Ltd.	
	Madigan, M. T., Martinko, J. M., Bender, K. S., Buckley, D. H. and Stahl, D. A., Brock Biology of Microorganisms, Pearson Education Limited.	
	Mahanta, K. C., Fundamentals of Agricultural Microbiology, Oxford & IBH Publishers	
	Somani, L.L., Biofertilizers in Indian Agriculture, Concept Publishing Company.	
	Subba Rao, N.S., Biofertilizers in Agriculture and Forestry, International Science Publishers.	
	Subba Rao, N. S., Advances in Agricultural Microbiology, Oxford & IBH Publishers.	
	Veeresh, G. K. and Rajagopal, D., Applied Soil Biology and Ecology, Oxford & IBH Publishing Company Pvt. Limited.	
Learning Outcomes	1. Apply the knowledge of soil chemistry and significant biochemical processes of microbes to improve agricultural practices. 2. Apply the understanding of role of microorganisms in plant growth promotion and control of disease and pests.	

Programme: M.Sc. (Microbiology)
Course Code: MIPE-403
Title of the Course: AGRICULTURE MICROBIOLOGY [P]
Number of Credits: 1, Practical
Contact hours: 30
Effective from Academic Year: 2022-23

Prerequisites	It is assumed that the student have knowledge about the soil properties and microbial interactions with plants.	
Objective:	Assessing the diverse parameters influencing the soil health. Studying the plant growth promoters and plant pathogens.	