



SRI VENKATESWARA UNIVERSITY, TIRUPATHI

V SEMESTER SYLLABUS(w.e.f.- 2025-26)

B.Sc. Honours COURSE IN MICROBIOLOGY (MAJOR)

COURSE STRUCTURE

Year	Semester	Course	Title	Hr/ week	credits
I	I	1	Introduction to Classical Biology	5	4
		2	Introduction to Applied Biology	5	4
	II	3	Introduction to Microbiology	3	3
			Introduction to Microbiology	2	1
		4	Bacteriology and Virology	3	3
			Bacteriology and Virology	2	1
II	III	5	Eukaryotic microorganisms	3	3
			Eukaryotic microorganisms	2	1
		6	Biomolecules & Enzymology	3	3
			Biomolecules & Enzymology	2	1
		7	Microbial and Analytical Techniques	3	3
			Microbial and Analytical Techniques	2	1
		8	Cell Biology and Genetics	3	3
			Cell Biology and Genetics	2	1
	IV	9	Molecular Biology and Microbial Genetics	3	3
			Molecular Biology and Microbial Genetics	2	1
		10	Microbial Physiology and Metabolism	3	3
			Microbial Physiology and Metabolism	2	1
		11	r DNA technology, Biostatistics & Bioinformatics	3	3
			r DNA technology, Biostatistics & Bioinformatics	2	1
III	V	12 A	Immunology & Medical Microbiology	3	3
			Immunology & Medical Microbiology	2	1
			OR		
		12 B	Pharmaceutical Microbiology	3	3
			Pharmaceutical Microbiology	2	1

		13 A	Applied Microbiology	3	3
			Applied Microbiology	2	1
		OR			
		13 B	Diagnostic Microbiology	3	3
			Diagnostic Microbiology	2	1
		14 A	Industrial Microbiology	3	3
			Industrial Microbiology	2	1
		OR			
		14 B	Agricultural Microbiology	3	3
			Agricultural Microbiology	2	1

		15 A	Food and Dairy Microbiology	3	3
			Food and Dairy Microbiology	2	1
		OR			
		15 B	Environmental Biotechnology	3	3
			Environmental Biotechnology	2	1
		VI	Internship		
	IV	VII	16	VII & VIII semester syllabus will be available in due course of time	
			17		
			18		
			19		
		SEC	20		
			21	VII & VIII semester syllabus will be available in due course of time	
		VIII	22		
			23		
			24		
		SEC	25		

V SEMESTER
COURSE 12 A: IMMUNOLOGY AND MEDICAL MICROBIOLOGY

I Course outcomes:

By the Completion of the course, the learner should be able to–

1. Describe the key concepts in Immunology and how the immune system is able to discriminate self vs. non-self
2. Explain how the innate and adaptive immune systems work together to generate an effective immune response against a specific pathogen.
3. Explain how the immune system is able to respond to so many diverse antigens.
4. To understand the importance of pathogenic microorganisms in human disease with respect to infections of the respiratory tract, gastrointestinal tract, urinary tract, etc
5. To understand and be able to correlate disease symptoms with the causative agent, isolate, and identify pathogens.

Unit - 1: Immune System

No. of Hours:9

1. Concept of Innate and Adaptive immunity
2. Primary and secondary organs of the immune system - thymus, bursa fabricius, bone marrow, spleen, lymph nodes, and lymphoid tissues
3. Cells of the immune system- Identification and function of B and T lymphocytes, null cells, monocytes, macrophages, neutrophils, basophils, and eosinophils
Components of innate immunity; Complement system (in brief)

Unit - 2: Immune response

No. of Hours 9

1. Characteristics of antigen (Foreignness, Molecular size, Heterogeneity and solubility) haptens.
2. Antibodies - basic structure and types.
3. Generation of Immune Response - Primary and Secondary Generation of Humoral Immune Response (Plasma and Memory cells), MHC Generation of Cell Mediated Immune Response
4. Immune complex formation and elimination - Agglutination, Precipitation, Neutralisation, Complement fixation, Phagocytosis
5. Hypersensitivity- definition and types (in brief)

Unit - 3: Microbes in Health and Disease

No. of Hours:9

1. Normal flora of human body.
2. Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Opportunistic infections, Nosocomial infections.
3. General account on microbial diseases - causal organism, pathogenesis, epidemiology, diagnosis, prevention and control of the following
Bacterial diseases - Tuberculosis, Typhoid, Botulism

Fungal diseases - Candidiasis.
Viral Diseases - Hepatitis- A and AIDS

Unit - 4: Principles of Diagnosis

No. of Hours:9

1. General principles of diagnostic microbiology- Collection, transport of clinical samples
2. Identification by culturing
3. Identification by biochemical/physiological properties
4. Identification by molecular assays (PCR, DNA probes)
5. Identification by serological tests (ELISA, Immunofluorescence, Agglutination-based tests, Complement fixation)

Unit - 5: Prevention and Treatment

No. of Hours:9

1. Vaccines - Active (Natural and recombinant) and passive
2. Antimicrobial agents- General modes of action of antibacterial (Penicillin, Streptomycin), antifungal (Amphotericin and Griseofulvin), antiviral (Amantadine, Acyclovir) agents
3. Interferons
4. Antibiotic resistance -Tests for antimicrobial susceptibility (Disc diffusion)

II Skill Outcomes:

By the completion of the course, the learner should be able to– 1. Perform some of the ag-ab reactions

2. Carry out the biochemical tests functional for the identification of bacteria
3. Perform an antibiotic sensitivity test
4. Identify some common symptoms and relate them to etiology
5. Prepare some differential media routinely used for the identification of bacteria

V SEMESTER

COURSE 12 A: IMMUNOLOGY AND MEDICAL MICROBIOLOGY

credits -1

1. Identification of human blood groups.
2. Separate serum from the blood sample (demonstration).
3. Immunodiffusion by the Ouchterlony method.
4. Identification of any of the bacteria (E. coli, Pseudomonas, Staphylococcus, Bacillus) using laboratory strains based on cultural, morphological, and biochemical characteristics: IMViC, urease production, and catalase tests
5. Study of composition and use of critical differential media for identification of

6. Bacteria: EMB Agar, McConkey agar, Mannitol salt agar, Deoxycholate citrate agar, TCBS. Isolation of Bacterial Flora from Skin Using the Swab Method.
7. Antibacterial sensitivity by Kirby-Bauer method
8. Determination of minimal inhibitory concentration of an antibiotic
9. Study symptoms of the diseases with the help of photographs: Anthrax, Polio, Herpes, chicken pox, HPV warts, Dermatomycoses (ringworms)
10. Isolation of Normal flora of the human body (Hands, Feet, Nostrils, and Teeth Surface) by swab method.

III References

1. Ananthanarayan R. and Paniker C.K.J. (2009). Textbook of Microbiology. 8th edition, University Press Publication.
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A., and Mietzner, T.A. (2013). Jawetz, Melnick, and Adelberg's Medical Microbiology. 26th edition. McGraw-Hill Publication.
3. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11th edition. Wiley-Blackwell Scientific Publication, Oxford.
4. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.
5. Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.
6. Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Microbiology. 4th edition. Elsevier Publication.
7. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education Practical microbiology- M.N.Reddy Practical microbiology-M.N.Reddy
8. Microbiology: a laboratory manual / James G. Cappuccino, Natalie.
9. Plant Pathology and Microbiology-K.R.Aneja
10. Mackie & McCartney Practical Medical Microbiology,

VI. Co-Curricular Activities:

1. Screening of Blood Groups
2. Visit to Diagnostic /Laboratories
3. Competition on composition and sterile media preparation
4. Competition on Isolation and Identification of bacteria from a sample

V SEMESTER
COURSE 12 B: PHARMACEUTICAL MICROBIOLOGY
credits -3

Course Outcomes:

On completion of the course, the learner should be able to–

1. Explain the principles of biosafety cabinets and biological waste management
2. Explain the methods of detection of microorganisms in pharmaceuticals.
3. Explain the molecular methods of detection of pathogens for quality control
4. Design/select specific media for identification of microbes in pharmaceutical products
5. Practice safety principles

Unit 1: Introduction to Pharmaceutical Microbiology

No. of Hours: 9

1. Significance of microbiology in the pharmaceutical industry; Microbial contamination and spoilage of pharmaceutical products.
2. Overview of current Good Manufacturing Practices (GMP) and regulatory requirements.
3. Principles of aseptic techniques and cleanrooms, BSL

Unit 2: Microbial Control in Pharmaceuticals

No. of Hours: 9

1. Sterilization methods: physical and chemical sterilization techniques.
2. Sterility testing: principles, methods, and interpretation of results.
3. Disinfection methods: types of disinfectants, their modes of action, and applications.
4. Microbial preservation of pharmaceutical products: antimicrobial agents and their efficacy.

Unit 3: Microorganisms of Pharmaceutical Importance

No. of Hours: 9

1. Identification and characteristics of microorganisms commonly found in pharmaceutical environments.
2. Pathogenic microorganisms and their significance in pharmaceutical products.
3. Environmental monitoring and microbial enumeration techniques; Bioburden testing and its importance

Unit 4: Microbial Quality Control

No. of Hours: 9

1. Validation and qualification of manufacturing processes and equipment.
2. Control of raw materials, water, and air quality in pharmaceutical production.
3. Quality control testing for microbial limits, endotoxin levels, and bioburden.

4. Environmental monitoring and trend analysis in pharmaceutical facilities.

Unit 5: Microbiology in Product Development

No. of Hours: 9

1. Microbial aspects of product development and formulation.
2. Microbial stability testing of pharmaceutical products.
3. Microbial assays for antibiotics and other pharmaceutical substances.
4. 4. Microbial quality control in vaccine production.

Skill Outcomes: By the completion of the course, the learner should be able to—

1. Perform sterility tests for equipment.
2. Employ disinfection methods for selected instruments
3. Perform sterility test of air in the lab
4. Test the sterility of microbiological media
5. Test the sterility of pharmaceutical products

V SEMESTER

COURSE 12 B: PHARMACEUTICAL MICROBIOLOGY

credits -1

1. Sterility tests for Instruments – Autoclave & Hot Air Oven
2. Disinfection of selected instruments & equipment
3. Sterility test of Air in the Laboratory.
4. Sterility testing of Microbiological media
5. Sterility testing of Pharmaceutical products –Antibiotics, Vaccines & fluids
6. Standard qualitative analysis of water.
7. Analysis of food samples for Mycotoxins

III.References

1. Harrigan WF (1998) Laboratory Methods in Food Microbiology, 3rd ed. Academic Press
2. Garg N, Garg KL and Mukerji KG (2010) Laboratory Manual of Food Microbiology I K International Publishing House Pvt. Ltd.
3. Jay JM, Loessner MJ, Golden DA (2005) Modern Food Microbiology, 7th edition. Springer
4. Baird RM, Hodges NA and Denyer SP (2005) Handbook of Microbiological Quality control in Pharmaceutical and Medical Devices, Taylor and Francis Inc.
5. Microbiology - A laboratory manual, Cappuccino & Sherman, 6 th Ed, Pearson Education
6. Manual of diagnostic microbiology, Dr. B.J. Wadher & Dr. G.L.Bhoosreddy, First
7. .Ed ., Himalaya Publishing House, Nagpur.
8. Pharmaceutical Microbiology – W.B. Hugo
9. Pharmaceutical Microbiology – Purohit
10. Laboratory Exercises in Microbiology, George A. Wistreich & Max D.Lechtman, 3rd Ed, Glencoe Press, London.

IV.Co-Curricular Activities:

1. Visit to Pharmaceutical Companies
2. Project on QC and QA methods in pharma
3. Assignments on collecting SoPs from Pharma labs

V SEMESTER
COURSE 13 A: APPLIED MICROBIOLOGY
credits -3

I.Course Outcomes:

By the completion of the course, the learner should be able to–

1. Identify the areas of entrepreneurship, and assess the scope for establishment.
2. Explain the production of fermentation products and economics
3. Explain the production method of biofertilisers and mushrooms
4. Explain the process of baking and brewing
5. Prepare DPR and understand patenting

Unit–I: Entrepreneurial skill

No of Hours: 9

Entrepreneurial skills–Institutes involved, Government support to entrepreneurs, Incubation centers, risk assessment. Scope for small, medium, and large-scale industries in Microbiology

Unit–II: Fermentation Products No of Hours: 9

1. Microbial cells as fermentation products–
2. Bakers yeast, food and feed yeasts, SCP, Bacterial Insecticides, Legume Inoculants, Algae.
3. Enzymes as fermentation products–
4. Bacterial and Fungal Amylases, Proteolytic Enzymes, Pectinases, Invertases, and other enzymes
5. Fermentation Economics

Unit–III: Bio-fertilisers and Mushrooms No of Hours: 9

1. Mushroom cultivation–Cultivation of *Agaricus campestris*, *Calocybe inodora*, *Agaricus bisporus*, and *Volvarela volvacea*; Preparation of compost, filling tray beds, spawning, maintaining optimal temperature, casing, watering, harvesting, and storage.
2. Biofertilizers –Chemical fertilizers versus biofertilizers, organic farming. Production of *biofertilisers-Rhizobium sp*, *Azospirillum sp*, *Azotobacter sp*.
3. Microbial consortia for composting and as biofertilisers

Unit–IV: Baking and Brewing processes No of Hours: 9

Brewing–Media components, preparation of medium, Microorganisms involved, maturation, carbonation, packaging, keeping quality, contamination, by-products. Bread making- Yeast activation,

Unit–V: DPR and Patents

No of Hours: 9

1. Preparation of DPR (Detailed Project Report)
2. Patents and secret processes –History of patenting, composition, subject matter and characteristics of a patent, Inventor, Infringement, cost of patent. **Skill**

Outcomes:

By the completion of the course, the learner should be able to–

1. Prepare Microbial consortia for composting
2. Prepare a report on the working of the production unit of mushrooms/biofertiliser
3. Prepare sample DPR

V SEMESTER COURSE 13 A: APPLIED MICROBIOLOGY

credits -1

1. Preparation of Microbial consortia for composting
2. Field visit and report preparation of Mushroom cultivation unit/ Biofertiliser production centre/or any other
3. Preparation of sample DPR

References:

1. Entrepreneurial Development in India -By Arora.
2. Sathyanarayana, U., Biotechnology.(2005) 1st Ed. Books and Allied (P) Ltd.
3. Casida, LEJR, (2019). Industrial Microbiology. New Age International Publishers
4. K.R. Aneja, Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom production technology, 6th Ed. S Chand Publication
5. Nduka Okafor. Modern Industrial Microbiology and Biotechnology. 2007. CRC Press
6. Michael J. Waites, Neil L. Morgan, John S. Rockey, Gary Higton. Industrial Microbiology: An Introduction. 2013. Wiley Blackwell Publishers.
7. A.H. Patel. Industrial Microbiology. 2016. 2nd Ed. Laxmi Publications, New Delhi.
8. Dubey RC. A Textbook of Biotechnology. (2014). S Chand Publishers.
9. Robert D. Hisrich, Michael P. Peters, "Entrepreneurship Development", Tata McGraw Hill

II. Co-Curricular Activities:

1. Prepare fermented foods
2. Workshop on project report preparation of mushroom cultivation unit
3. Visit to industry producing microbial products

V SEMESTER COURSE 13 B: DIAGNOSTIC MICROBIOLOGY

credits -3

Course Outcomes:

By the completion of the course, the learner should be able to

1. To differentiate and explain various methods of staining and media preparation.
2. Explain the principle and application of serological and molecular methods of diagnosis
3. Safeguard oneself and community from antibiotic misuse.
4. Analyse the incidence, distribution and determinants of diseases.
5. To execute the methods of prevention of various infectious diseases

Syllabus:

UNIT- I: Collection of Clinical Samples No. of hours: 9

1. Clinical samples associated with various infectious diseases
2. Collection of clinical samples (oral cavity, throat, skin, blood, CSF, urine, and faeces) and precautions required.
3. Method of transport of clinical samples to the laboratory and storage.
4. Laboratory-acquired infections, safety of laboratory workers

UNIT- II: Microscopic and culture methods of Diagnosis No. of hours: 9

1. Examination of sample by staining - Gram stain, Ziehl-Neelson staining for tuberculosis, Giemsa-stained thin blood film for malaria
2. Preparation and use of culture media - Blood agar, Chocolate agar, Lowenstein-Jensen medium, MacConkey agar
3. Distinct colony properties of various bacterial pathogens.

UNIT-III: Serological molecular methods of Diagnosis 9h

1. Agglutination, ELISA, immunofluorescence
2. PCR and Its Variations: Real-Time and Digital PCR for Nucleic Acid Quantification; Multiplex PCR for Detection and Identification of Microbial Pathogens
3. Nonamplified Probe-Based Microbial Detection and Identification

UNIT- IV: Antimicrobials- sensitivity and resistance No. of hours:9

1. Importance of drug resistance
2. Determination of resistance/sensitivity of bacteria by the disc diffusion method
3. Determination of minimal inhibitory concentration (MIC) of an antibiotic by serial double dilution method

UNIT- V: Advances in Diagnostic Microbiology No. of hours:9

1. Metagenomic studies for Pathogen Detection and Identification
2. Transcriptomic Techniques in Diagnostic Microbiology

3. Developments in molecular tests for detecting TB and anti-TB drug resistance.

Skill Outcomes:

1. Collect, label, and transport clinical specimens
2. Isolate pure culture of bacteria
3. To identify common bacteria
4. To maintain and preserve stock culture

V SEMESTER

COURSE 13B : DIAGNOSTIC MICROBIOLOGY

credits -1

1. Collection, transport, and processing of clinical specimens (Blood, Urine, Stool, and Sputum).
2. Receipts, Labeling, recording, and dispatching clinical specimens.
3. Isolation of bacteria in pure culture and Antibiotic sensitivity.
4. Identification of common bacteria by studying their morphology, cultural characters, Biochemical reactions, slide agglutination, and other tests.
5. Maintenance and preservation of stock culture.

References

1. Ananthanarayan R and Paniker CKJ (2009) Textbook of Microbiology, 8th edition, Universities Press Private Ltd.
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw-Hill Publication.
3. Randhawa, VS, Mehta G and Sharma KB (2009) Practicals and Viva in Medical Microbiology 2nd edition, Elsevier India Pvt Ltd.
4. Tille P (2013) Bailey's and Scott's Diagnostic Microbiology, 13th edition, Mosby.
5. Collee JG, Fraser, AG, Marmion, BP, Simmons A (2007) Mackie and McCartney Practical Medical Microbiology, 14th edition, Elsevier.

Co-Curricular Activities:

1. Hands-on training in techniques such as sample collection, microbial culture, staining, identification methods (e.g., biochemical tests), and antimicrobial susceptibility testing.

2. Case Study Analysis individually or in groups to evaluate patient histories, laboratory test results, and diagnostic data to reach a diagnosis.
3. Project work on comparing reports from different diagnostic labs

V SEMESTER
COURSE 14 A: INDUSTRIAL MICROBIOLOGY
credits -3

Course Outcomes:

By the Completion of the course, the learner should be able to– 1.

- Recognize various industrially important microorganisms
2. Identify the methods of screening of required microorganisms
3. Identify the appropriate methods of fermentation to be adapted for production
4. Discuss the basic concepts in industrial microbiology, industrially essential microbes, and metabolites
5. Explain the components of upstream and downstream bioprocessing

UNIT I: Microorganisms of industrial importance **No. of hours: 9**

1. Brief history and developments in industrial microbiology.
2. Microorganisms of industrial importance -yeasts (*Saccharomyces cerevisiae*), molds (*Aspergillus niger*), bacteria (*E. coli*), actinomycetes (*Streptomyces griseus*).
3. Industrially important Primary and secondary microbial metabolites- Techniques involved in the selection of industrially essential metabolites from microbes.

UNIT II: Screening and Strain Improvement **No. of hours: 9**

1. Primary and secondary screening. Preservation and maintenance of industrial strains
2. Outlines of strain improvement.
3. Fermentation media (Crude and synthetic media; molasses, corn-steep liquor, sulphite waste liquor, whey, yeast extract, and protein hydrolysates)

UNIT III: Bioreactors **No. of hours: 9**

1. Components of a typical continuously stirred tank bioreactor.
2. Types of fermenters – laboratory, pilot-scale, and production fermenters.
3. Types of fermentation processes- solid state, liquid state; batch, fed-batch, continuous; aerobic, anaerobic; submerged, surface

UNIT IV: Fermentation and Downstream Processes **No. of hours: 9**

1. Measurement and control of fermentation parameters - pH, temperature, dissolved oxygen, foaming, and aeration
2. Downstream processing - filtration, centrifugation, cell disruption, solvent extraction.
3. Methods of immobilization, advantages and applications of immobilization, large scale applications of immobilized enzymes.

UNIT V: Microbial Productions**No. of hours: 9**

1. Production of citric acid, ethanol and penicillin.
2. Production of Glutamic acid and vitamin B12
3. Industrial production and uses of amylases, proteases, lipases and cellulases.

Skill Outcomes:

By the completion of the course, the learner should be able to–

1. Comprehend the significance of and demonstrate microbial diversity by isolating microorganisms from natural environments.
2. Microscopically demonstrate the microorganisms found in fermented food; prepare some of the fermented products(wine) in the laboratory to observe the associated physical and chemical changes.
3. Carry out microbial productions on a small scale (citric acid) and estimate the product

V SEMESTER**COURSE 14 A INDUSTRIAL MICROBIOLOGY****credits -1**

1. Microbial fermentation for the production and estimation of ethanol
2. Isolation of amylase-producing microorganisms from soil
3. Production of amylase from bacteria and fungi
4. Assay of amylase
5. Demonstration of fermenter
6. Production of wine from grapes
7. Growth curve and kinetics of any two industrially essential microorganisms.
8. Microbial fermentation for the production and estimation of citric acid

References:

1. Stanbury, P.F., Whitaker, A. and Hall, S.J. (1997). Principles of Fermentation Technology, Aditya Books (P) Ltd., New Delhi.
2. Doyle, M.P., Beuchat, L.R., and Montville, T.J. (1997). Food Microbiology: Fundamentals and Frontiers. ASM Press, Washington, D.C., USA.

Co-Curricular Activities:

1. Lectures/ Seminar on current trends in industrial microbiology
2. Field visit to the related industries

3. Assignments on identifying and procuring industrially important microorganisms

V SEMESTER

COURSE 14 B: AGRICULTURAL MICROBIOLOGY

credits -3

COURSE OUTCOMES:

By the completion of the course, the learner should be able to

1. Soil Microbiology: Study soil as a microbial habitat, the diversity of microorganisms, and their interactions.
2. Host Pathogen Interaction: Understand microbial pathogenicity, virulence factors, and plant defense mechanisms.
3. Control of Plant Diseases: Learn principles and practices for managing plant diseases, including regulatory, cultural, chemical, and biological methods.
4. Specific Plant Diseases: Study essential plant diseases caused by fungi, bacteria, viruses, and viroids, focusing on their etiology, symptoms, epidemiology, and control.
5. Biofertilization, Phyto stimulation, Bioinsecticides: Explore plant growth-promoting bacteria, biofertilizers, mycorrhizae, and their role in enhancing plant growth. Learn about bioinsecticides and their advantages over synthetic pesticides.

Unit 1: Soil Microbiology

No of Hours: 9

1. Soil as Microbial Habitat, Soil profile and properties, Soil formation, Diversity and distribution of microorganisms in soil.
2. Mineralization of cellulose, hemicelluloses, lignocelluloses, lignin, and humus.
3. Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation. Microbe-Plant interaction: Symbiotic and non-symbiotic interactions.

Unit 2: Host Pathogen Interaction

No. of Hours: 9

1. Microbial Pathogenicity Virulence factors of pathogens: enzymes, toxins (host-specific and non-specific), and growth regulators. Virulence factors in viruses (replicase, coat protein, silencing suppressors) in disease development.
2. Effects of pathogens on host physiological processes (photosynthesis, respiration, cell membrane permeability, translocation of water and nutrients, plant growth and reproduction).
3. Defence Mechanisms in Plants: Concepts of constitutive defense mechanisms in plants, inducible structural defences (histological cork layer, abscission layer, tyloses, gums), inducible biochemical defences [hypersensitive response (HR), systemic acquired resistance (SAR), phytoalexins, pathogenesis related (PR) proteins, plantibodies, phenolics, quinones, oxidative bursts].

Unit 3: Control of Plant Diseases**No. of Hours: 9**

1. Principles & practices involved in the management of plant diseases by different methods, viz. regulatory quarantine, crop certification, avoidance of pathogen, use of pathogen free propagative material, cultural - host eradication, crop rotation, sanitation, polyethylene traps and mulches, chemical-protectants and systemic fungicides, antibiotics, resistance
2. of pathogens to chemicals. biological - suppressive soils, antagonistic microbes- bacteria and fungi, trap plants
3. Genetic engineering of disease-resistant plants- with plant-derived genes and pathogen-derived genes, and Genetically Modified crops.

Unit: 4: Study of Plant Diseases No. of Hours: 9

Study of some important plant diseases emphasizing their etiological agents, symptoms, epidemiology, and control

1. Important diseases caused by fungi
 - a. Black stem rust of wheat - *Puccinia graminis tritici*
 - b. Wilt of tomato - *Fusarium oxysporum f. sp. lycopersici*
 - c. Early blight of potato - *Alternaria solani*
2. Important diseases caused by phytopathogenic bacteria:

Angular leaf spot of cotton, bacterial leaf blight of rice, crown galls, bacterial cankers of citrus
3. Important diseases caused by viruses: Papaya ring spot, tomato yellow leaf curl. Essential diseases caused by viroids: Potato spindle tuber, coconut cadang-cadang

Unit 5: Biofertilization, Phyto stimulation, Bioinsecticides No of Hours: 9

1. Plant growth-promoting bacteria, biofertilizers – symbiotic (Bradyrhizobium, Rhizobium, Frankia), non-symbiotic (Azospirillum, Azotobacter, Phosphate solubilizers, algae)
2. Importance of mycorrhizal inoculum, types of mycorrhizae and associated plants, Mass inoculum production of VAM, field applications of Ectomycorrhizae and VAM.
3. General account of microbes used as bioinsecticides and their advantages over synthetic pesticides, Bacillus thuringiensis- production and Field applications, Viruses – cultivation and field applications.

Skill Outcomes:

1. Understand soil composition and characteristics, measuring water activity and pH levels, interpreting soil profiles, and recognizing the influence of these factors on soil fertility and plant growth.
2. Identifying soil microorganisms
3. Understand Rhizobium's characteristics, demonstrate field application techniques, and recognize the importance of Rhizobium inoculation in enhancing plant growth and soil fertility.
4. Demonstrate field application techniques, and recognize the role of Azotobacter in promoting plant growth and soil nitrogen availability.

5. Identify cellulose-degrading microorganisms
6. Identify the plant diseases based on section cuttings

V SEMESTER

COURSE 15 A: FOOD AND DAIRY MICROBIOLOGY

credits -3

Course Outcomes: By the Completion of the course, the learner should be able to–

1. Understand the factors influencing microbial growth, contamination in foods, and sources of microbial contamination.
2. Gain knowledge of the Microflora of milk, microbial contamination of raw milk and butter, and spoilage of various food types.
3. Use dairy starter cultures in fermented dairy products, other fermented foods, and probiotics.
4. Differentiate Foodborne diseases, intoxications, and infections
5. To adopt food sanitation, control measures, follow HACCP; Carry out tests to detect pathogens in foods

Unit 1: Microbes in Food and Dairy

No. of Hours: 9

1. Intrinsic and extrinsic factors that affect the growth and survival of microbes in foods, natural flora, and the source of contamination of foods in general.
2. Microflora associated with milk and milk products and their importance. Sources of microbial contamination of raw milk and butter
3. Sources of microbial contamination and spoilage of vegetables, fruits, meat, eggs, bread, canned Foods;

Unit 2: Food Preservation

No. of Hours: 9

1. Principles of food preservation: temperature, canning, drying, irradiation, microwave processing, and aseptic packaging. Chemical methods of food preservation: salt, sugar, organic acids, SO₂, citrates, benzoates, nitrite, and nitrates, etc.
2. Microbial and chemical changes in raw milk during chilling and refrigeration.
3. Naturally occurring preservative systems in milk, like the LP system, Immunoglobulins, Lysozyme, and Lactoferrin. Food grade Biopreservatives (GRAS), Bacteriocins of lactic acid bacteria; Nisin and other antimicrobials produced by Lactic Acid Bacteria (LAB)

Unit 3: Fermented foods

No. of Hours: 9

1. Dairy starter cultures, fermented dairy products: yogurt, acidophilus milk, kumiss, kefir, dahi, and cheese
2. Other fermented foods: dosa, sauerkraut, soy sauce, and tempeh. Probiotics: Health benefits, types of microorganisms used, and probiotic foods available in the market.

3. Utilization and disposal of dairy by-products – whey.

Unit 4: Food borne diseases

No. of Hours: 9

1. Food borne diseases (causative agents, foods involved, symptoms and preventive measures)
2. Food intoxications: *Staphylococcus aureus*, *Clostridium botulinum* and mycotoxins;
3. Food infections: *Bacillus cereus*, *Vibrio parahaemolyticus*, *Escherichia coli*, Salmonellosis,
4. Shigellosis, *Yersinia enterocolitica*, *Listeria monocytogenes* and *Campylobacter jejuni*

Unit 5: Food Sanitation

No. of Hours: 9

1. Food sanitation and control; HACCP; National and International microbiological standards for dairy products (BIS, ICMSF, Codex Alimentarius Standards.
2. Cultural and rapid detection methods of food borne pathogens and introduction to predictive microbiology.
3. Genetically modified foods, Nutraceuticals, Biosensors in food, Applications of microbial enzymes in dairy industry [Protease, Lipases].

Skill Outcomes:

1. Mastering the MBRT method and standard plate count technique, interpreting MPN results, assessing milk quality based on microbial load, and understanding the significance of microbial analysis in ensuring milk safety.
2. Check the efficiency of pasteurization of milk include understanding the principle of the test, performing the enzymatic reaction, interpreting results, and assessing the effectiveness of milk pasteurization in ensuring food safety.
3. Mastering aseptic techniques, perform sample preparation and isolation techniques, identify potential pathogens and spoilage microorganisms, and understand the role of microorganisms in food safety and spoilage.
4. Follow yogurt fermentation protocols, controlling fermentation conditions, assessing yogurt quality, and understanding the role of microbial cultures in yogurt production.

V SEMESTER

COURSE 15 A: FOOD AND DAIRY MICROBIOLOGY

credits -1

1. MBRT of milk samples and their standard plate count.
2. Alkaline phosphatase test to check the efficiency of pasteurization of milk.
3. Isolation of any foodborne bacteria from food products. Isolation of spoilage microorganisms from spoiled vegetables/fruits.
4. Isolation of spoilage microorganisms from bread.
5. Preparation of Yogurt/Dahi.

References

1. Stanbury, P.F., Principles of Fermentation Technology. Whittaker, A, and Hall, S.J. 2nd Edition. Pergamon Press (1995).
2. Banwart, GJ. Basic Food Microbiology. CBS Publishers Delhi. (1989).
4. Hobbs BC and Roberts D. Food poisoning and Food Hygiene. Edward Arnold (A division of Hodder and Stoughton), London.
5. Joshi. Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology. Volume 2.
6. John Garbult. Essentials of Food Microbiology. Arnold International.
7. John C. Ayres. J. Orwin Mundt. William E. Sandinee. Microbiology of Foods. W.H. Freeman and Co.
9. D. J. Bagyaraj and G. Rangaswami. AGRICULTURAL MICROBIOLOGY. Prentice Hall of India Pvt Ltd. 2005
10. N S Subba Rao. Soil Microbiology. Oxford and IBH Publishing Company, 2009
11. Photis Papademas. Dairy Microbiology: A Practical Approach. CRC Press
12. Rao M.K. Food and Dairy Microbiology. Manglam Publishers
13. William Frazier. Food Microbiology. McGraw-Hill Education
14. Jay, James M., Loessner, Martin J., Golden, David A. Modern Food Microbiology. Springer.

Co-Curricular Activities:

1. Food Microbiology Workshops
2. Assign projects or lab exercises where students analyze food and dairy products for microbial quality and safety.
3. Organize visits to food processing facilities or dairy
4. Seminars on Food Safety and Quality Assurance, food regulations, and quality management systems.

V SEMESTER

COURSE 14 B: AGRICULTURAL MICROBIOLOGY

credits -1

1. Study soil profile, water holding capacity, and pH
2. Study microflora of different types of soils
3. Rhizobium as a soil inoculant: characteristics and field application
4. Azotobacter as a soil inoculant: characteristics and field application
5. Isolation of cellulose-degrading microorganisms
6. Demonstration of Koch's postulates in fungal, bacterial, and viral plant pathogens.
7. Study of essential diseases of crop plants by cutting sections of infected plant material (microscopic observations)-Albugo, Puccinia, Ustilago, Fusarium, Colletotrichum.

References:

1. AgriosGN.(2006).Plant Pathology. 5th edition.Academic Press, SanDiego,
2. .LucasJA.(1998).Plant Pathology and Plant Pathogens. 3rd edition.BlackwellScience, Oxford.
3. Mehrotra RS.(1994).Plant Pathology. Tata McGraw-Hill Limited.
4. RangaswamiG.(2005).Diseases of Crop Plants in India. 4th edition.Prentice Hall India Pvt.Ltd, New Delhi.
5. SinghRS.(1998).PlantDiseasesManagement.7thedition.Oxford&IBH, New Delhi.

Co-Curricular Activities:

1. Project on collecting photographs of diseased plants and identification
2. Project on collecting photographs of diseased plant parts and identification of the pathogen
3. Workshops/ Lectures on natural farming methods

V SEMESTER

COURSE 15 B: ENVIRONMENTAL MICROBIOLOGY

credits -3

Course Outcomes:

By the completion of the course, the learner should be able to

1. Explore ecosystems (terrestrial, aquatic, atmospheric) and microflora in soil, water, atmosphere, and human/animal bodies.
2. Learn about mutualism, synergism, commensalism, competition, parasitism, and predation in microbes. Study plant-microbe and animal-microbe interactions.
3. Understand microbial involvement in carbon, nitrogen, phosphorus, and sulfur cycles, including organic degradation and nutrient processes.
4. Study solid waste disposal (composting, landfill), liquid waste treatment (sewage), and microbial bioremediation (pesticides, hydrocarbons, metals).
5. Apply the microorganisms in bioremediation processes

Unit 1: Microorganisms and their Habitats

No. of Hours: 9

1. Structure and function of ecosystems Terrestrial Environment: Soil profile and soil microflora, Decomposition of plant organic matter.
2. Aquatic Environment: Microflora of freshwater and marine habitats. Atmosphere: Aeromicroflora and dispersal of microbes
3. Animal Environment: Microbes in/on human body (Microbiomics) & animal (ruminants) body.

Unit 2: Microbial Interactions

No. of Hours: 9

1. Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation. Microbe-Plant interaction: Symbiotic and non-symbiotic interactions
2. Microbe-animal interaction: Microbes in ruminants, nematophagus fungi, and symbiotic luminescent bacteria.
3. Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels.

Unit 3: Biogeochemical Cycling

No. of Hours: 9

1. Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin, and chitin
2. Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction
3. Phosphorus cycle: Phosphate immobilization and solubilisation. Sulphur cycle: Microbes involved in the sulphur cycle.

Unit 4: Waste Management**No. of Hours: 9**

1. Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal (composting and sanitary landfill)
2. Liquid waste management: Composition and strength of sewage (BOD and COD), Primary, secondary (oxidation ponds, trickling filter, activated sludge process, and septic tank), and tertiary sewage treatment
3. Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive test/MPN test, confirmed and completed tests for faecal coliforms, (b) Membrane filter technique, and (c) Presence/absence tests

Unit 5: Microbial Bioremediation**No. of Hours: 9**

1. Bioremediation: Principles and degradation of common pesticides, organic (hydrocarbons, oil spills) and inorganic (metals) matter, biosurfactants.
2. Bioleaching, mineral recovery, removal of heavy metals from aqueous effluents. Biodegradable plastics.
3. Biogas production: Methane and hydrogen production using microbial culture.

Skill Outcomes:

1. Assess soil properties (pH, moisture content, water holding capacity, percolation, capillary action) and understand their impact on plant growth and soil fertility.
2. Isolate bacteria and fungi from soil samples, and comprehend the diverse microbial communities present in soil ecosystems.
3. Master techniques to isolate bacteria and fungi associated with plant roots, understand their ecological roles, and appreciate the significance of plant-microbe interactions in nutrient cycling and plant health.
4. Use the MPN method to evaluate microbial populations in water samples, and understand the importance of water quality monitoring for public health.
5. Measure BOD and COD in wastewater, and comprehend their significance in assessing pollution levels and wastewater treatment efficiency.

V SEMESTER**COURSE 15 B: ENVIRONMENTAL MICROBIOLOGY**

Practical

02 hr/week credits -1

1. Analysis of soil - pH, water holding capacity, percolation, and capillary action.
2. Isolation of microbes (bacteria & fungi) from soil.
3. Isolation of microbes (bacteria & fungi) from rhizosphere and rhizoplane.
4. Assessment of microbiological quality of water by the MPN method.
5. Determination of BOD of wastewater sample.
6. Determination of COD of wastewater sample
7. Study the presence of microbial activity by detecting (qualitatively) enzymes (dehydrogenase, amylase, urease) in soil.
8. Isolation of Rhizobium from root nodules.
9. Isolation of Azotobacter from soil.

10. Design and functioning of a biogas plant.

III. References

1. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA
2. Madigan MT, Martinko JM, and Parker J. (2014). Brock Biology of Microorganisms. 14th edition. Pearson/ Benjamin Cummings
3. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press
4. Okafor, N (2011). Environmental Microbiology of Aquatic & Waste Systems. 1st edition, Springer, New York
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8. Lynch JM & Hobbie JE. (1988). Microorganisms in Action: Concepts & Application in Microbial Ecology. Blackwell Scientific Publication, U.K.
9. Martin A. (1977). An Introduction to Soil Microbiology. 2nd edition. John Wiley & Sons Inc. New York & London.
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11. SubbaRao NS. (1999). Soil Microbiology. 4th edition. Oxford & IBH Publishing Co. New Delhi.
12. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw-Hill Higher Education.

IV. Co-Curricular Activities:

1. Project work on the assessment of different soil types
2. Prepare a Model of Biogas plant
3. Prepare a model of a sewage treatment plant

SRI VENKATESWARA UNIVERSITY, TIRUPATI
B.Sc COURSE IN MICROBIOLOGY V SEMESTER
MODEL QUESTION PAPER

Subject code-

MAX MARKS-75

TIME-3HRS

SECTION – A

Answer any five of the following short questions. Each carries 5 marks 5 X 5 = 25M

1. From unit 1
2. From unit 1
3. From unit 2
4. From unit 2
5. From unit 3
6. From unit 3
7. From unit 4
8. From unit 4
9. From unit 5
10. From unit 5

SECTION – B

Answer any five of the following essay questions. Each carries 10 marks, 5X10 =50 M

11. From unit 1 - a or b
12. From unit 2 - a or b
13. From unit 3 - a or b
14. From unit 4 - a or b
15. From unit 5 - a or b

SRI VENKATESWARA UNIVERSITY, TIRUPATI

III B.Sc. Microbiology MAJOR- SEMESTER –V

PRACTICAL EXAMINATION

Time : 3 hrs

Max Marks: 50

SECTION-A

Major experiment. $1 \times 15 = 15$ M

- a) Explain and demonstrate the given experiment

Scheme of evaluation: Demonstration(8M) + Description(7M)

SECTION-B

Minor experiment. $1 \times 10 = 10$ M

- b) Explain and demonstrate the given experiment

Scheme of evaluation: Demonstration(5M) + Description(5M)

SECTION-C

Spotters-Identify and give important features of given materials $5 \times 3 = 15$ M

c)

d)

e)

Scheme of evaluation: Identification(1M)+Diagram(2M)+Features(2M)=5 per spotter

RECORD – 5M

VIVA-VOCE – 5M