GOVERNMENT AUTONOMOUS COLLEGE
(AUTONOMOUS) RAJAMAHENDRAVARAM
NAAC "A^{+}" GRADE

DEPARTMENT OF MICROBIOLOGY

2025-2026

(Single Major & Minor-I, II, III & IV Semester as per BOS Regulations 2025-26)

GOVERNMENT COLLEGE (A), RAJAMAHENDRAVARAM
DEPARTMENT OF MICROBIOLOGY
BOARD OF STUDIES
Academic Year 2025-26
Programme: B.Sc., Honours in MICROBIOLOGY
COURSE STRUCTURE

Year	Semester	Course	Title
I	I	1	Introduction to Microbiology and Microbial Diversity
		2	Principles of Bacteriology & Microbial Techniques
II	III	5	Eukaryotic microorganisms
			Eukaryotic microorganisms
		6	Biomolecules & Enzymology
			Biomolecules & Enzymology
		7	Microbial and Analytical Techniques
			Microbial and Analytical Techniques
		8	Cell Biology and Genetics
			Cell Biology and Genetics
	IV	9	Molecular Biology and Microbial Genetics
			Molecular Biology and Microbial Genetics
		10	Microbial Physiology and Metabolism
			Microbial Physiology and Metabolism
		11	r DNA technology, Biostatistics& Bioinformatics
			r DNA technology, Biostatistics &Bioinformatics
III	V	12 A	Immunology & Medical Microbiology
			Immunology & Medical Microbiology
			OR
		12 B	Pharmaceutical Microbiology
			Pharmaceutical Microbiology
		13 A	Applied Microbiology
			Applied Microbiology
			OR
		13 B	Diagnostic Microbiology
			Diagnostic Microbiology
		14 A	Industrial Microbiology
			Industrial Microbiology
			OR
		14 B	Agricultural Microbiology
			Agricultural Microbiology
		15 A	Food and Dairy Microbiology
			Food and Dairy Microbiology

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

Andhra Pradesh State Council of Higher Education

MICROBIOLOGY: MINOR, w.e.f 2025-26 AY

COURSE STRUCTURE

Year	Semester	Course	Title	Hr/week	credits
II	III	2	Biomolecules & Enzymology	3	3
			Biomolecules & Enzymology	2	1
	IV	3	Molecular Biology and Microbial Genetics	3	3
			Molecular Biology and Microbial Genetics	2	1
		4	Microbial Physiology andMetabolism	3	3
			Microbial Physiology and Metabolism	2	1
III	V	5	Immunology & Medical Microbiology	3	3
			Immunology & Medical Microbiology	2	1
		6	Applied Microbiology	3	3
			Applied Microbiology	2	1

SEMESTER-I

COURSE 1: INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY

Theory

Credits: 3 **3 hrs/week**

I. Course Objectives:

1. To understand the historical development of microbiology, major contributions of key scientists, microbial classification systems, and the scope of microbiology.
2. To learn the general characteristics of bacteria, Archaea, Actinomycetes, and Viruses including the replication of Bacteriophage T2 and HIV.
3. To comprehend the general characteristics of microalgae, focusing on key genera like *Chlorella*, *Dunaliella*, and *Spirulina*.
4. To gain knowledge on general characteristics of fungi, with special emphasis on *Saccharomyces* and *Aspergillus*.
5. To understand the general characters and importance of protozoa, with focus on representative genera like *Amoeba* and slime molds.

II. Course Outcomes: On completion of this course students will be able to

1. Explain the important historical milestones, describe classification systems, differentiate prokaryotic and eukaryotic microorganisms, and list applications of microbiology.
2. Explain the general characters and significance of prokaryotic microorganisms and viruses, and describe the replication mechanisms of Bacteriophage T2 and HIV.
3. Describe the general characters and applications of microalgae and explain their economic importance.
4. Describe morphology of fungi, reproductive mechanisms and explain the economic importance of fungi.
5. Explain the general characters of protozoa and their significance in ecosystems, medicine, and scientific research.

III. Syllabus of Theory:

Unit 1: History and classification of Microbiology 10hrs

1.1Development of microbiology as a discipline, Spontaneous generation vs. biogenesis, Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Alexander Fleming, Ivanowsky.

1.2Systems of classification: Binomial Nomenclature; Whittaker's five kingdom Classification; Carl Woese's three kingdom classification systems, Concept of Species, Taxa, and Strain; Brief note on Bergey's Manual of Systematic Bacteriology;

Difference between prokaryotic and eukaryotic microorganisms; Definition and scope of Microbiology: Applications of Microbiology.

Unit 2: Prokaryotic microorganisms and Viruses 10hrs

2.1.General characteristics of bacteria and archaea: distribution, occurrence, morphology, reproduction and economic importance.

2.2.General characteristics of Viruses with emphasis on discovery of viruses, Nature and definition of viruses, morphology, reproduction and a brief note on Cultivation of Viruses

2.3General features of Viral Replication; Structure and multiplication of Bacteriophage T2 and HIV

Unit 3: Microalgae 8hrs

3.1.General characteristics of algae: occurrence, morphology, habitat, ecological distribution, photosynthetic pigments, food reserves, reproduction and role in aquatic ecosystems

3.2.Morphology, reproduction, ecological significance and applications of a) Chlorella (Chlorophyceae) and b) Spirulina (Cyanophyceae).

3.3.Economic Importance of Microalgae: Biofertilizers, Biofuels, Pharmaceuticals, Food supplements, Wastewater treatment, Carbon dioxide sequestration, algal polysaccharides.

Unit 4: Fungi 9hrs

4.1 Habitat, distribution, nutritional requirements, fungal cell ultra- structure, fungal wall, Outline classification of Fungi

4.2.Important Microfungi: Morphology and structure, reproduction and applications of a) Saccharomyces (Ascomycota – Yeast) and b) Aspergillus (Ascomycota)

4.3.Economic importance of fungi: in agriculture, food, industry, medicine.

Unit 5: Protozoa 8 hrs

5.1 General Characteristics of Protozoa: Morphology, Nutrition, reproduction, Habitat and ecological role

5.2.Important Protozoa: Morphology, locomotion, nutrition, reproduction, Ecological role of a)Amoeba and b) Slime Molds

5.3.Economic Importance of Protozoa (in ecosystems, waste management, soil fertility, research and Protozoa as pathogens).

IV. Reference Books:

a. Alexopoulos, C. J., Mims, C. W., & Blackwell, M. (1996). *Introductory Mycology*. John Wiley, New York.
b. Ali-Shtayeh, M. S., Jamous, R. M., & Yaghmour, R. M.-R. (1998).
    i. *Mycology manual*. An-Najah National University.

c. Becker, E. W. (2007). *Microalgae in Biotechnology*. Cambridge University Press.
d. Bessey, E. A. *Morphology and Taxonomy of Fungi*. Vikas Publishing House Pvt. Ltd., New Delhi.
e. Bold, H. C., & Wynne, M. J. (1985). *Introduction to the Algae: Structure and Reproduction* (2nd ed.). Prentice-Hall.
f. Deacon, J. W. (2006). *Fungal Biology* (4th ed.). Blackwell Publishing.
g. Funder, H. F. (1968). *Practical mycology: Manual for identification of fungi*. McGraw- Hill.
h. Garrity, G. M. (Ed.). (2011). *Bergey's Manual of Systematic Bacteriology* (2nd ed.). Springer.
i. Hausmann, K., & Bradbury, P. C. (2002). *Protistology* (2nd ed.). E. Schweizerbart'sche Verlagsbuchhandlung.
j. Jain, A., Agarwal, J., & Venkatesh, V. (2019). *Microbiology practical manual* (1st ed.). Elsevier India.
k. Kumar, H. D., & Singh, H. N. *A Textbook on Algae* (Macmillan International College Edition).
l. Lee, R. E. (2008). *Phycology* (4th ed.). Cambridge University Press.
m. Madigan, M. T., Martinko, J. M., Bender, K., Buckley, D., & Stahl,
j. D. (2021). *Brock Biology of Microorganisms* (16th ed.). Pearson Education.
n. Maheshwari, D. K. (2002). *Practical microbiology*. S. Chand Publishing.
o. Mehrotra, R. S., & Aneja, K. R. *An Introduction to Mycology*. New Age International Press, New Delhi.
p. Pelczar, M. J., Chan, E. C. S., & Krieg, N. R. (2009). *Microbiology: Concepts and Applications* (6th ed.). McGraw-Hill Education.
q. Prescott, L. M., Harley, J. P., & Klein, D. A. (2005). *Microbiology*
    i. (6th ed.). McGraw- Hill Education.
r. Sambamurty, V. S. S. (2010). *A Textbook of Algae*. I.K. International Publishing House Pvt. Ltd.
s. Tortora, G. J., Funke, B. R., & Case, C. L. (2020). *Microbiology: An Introduction* (13th ed.). Pearson Education.
t. Webster, J., & Weber, R. (2007). *Introduction to Fungi* (3rd ed.). Cambridge University Press.

2. Co- Curricular Activities
3. Arrange guest lectures, to provide insights into the latest advancements and emerging trends in bacteriology and virology.
4. Conduct hands-on microscopy workshops using to observe eukaryotic microorganisms
5. Organize field trips to natural habitats, such as forests, ponds, or marine environments, where eukaryotic microorganisms thrive.
6. Arrange culturing workshops where students can learn how to isolate and culture eukaryotic microorganisms in the laboratory.

SEMESTER-I

COURSE 1: INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY

Practical Credits: 1 2 hrs/week

I. Course objectives:

1. To learn preparation of culture media and techniques for isolation, identification, and preservation of fungi and algae.
2. To observe vegetative and reproductive structures of key fungal genera through slide preparations.
3. To study host-pathogen interaction and slime mold structures.

II. Laboratory/Field exercises:

1. Study of viruses (Bacteriophage, TMV and HIV) using micrographs
2. Preparation of Potato Dextrose Medium.
3. Isolation and identification of pathogenic and non-pathogenic fungi.
4. Study of host-pathogen interaction.
5. Study of the vegetative and reproductive structures of following genera through temporary and permanent slides: *Mucor, Saccharomyces, Penicillium, Agaricus* and *Alternaria*
6. Purification and preservation of pure cultures of common algae and fungi.
7. Observe prepared slides of slime mold structures.

SEMESTER-I

COURSE 2: PRINCIPLES OF BACTERIOLOGY & MICROBIAL TECHNIQUES

Theory Credits: 3 3 hrs/week

I.Course objectives

1. To understand the structure and function of prokaryotic cell components and their response to antibiotics.
2. To learn the key characteristics and ecological significance of Photosynthetic bacteria, Gliding bacteria, Mycoplasma, Fermentative bacteria, and Extremophiles.
3. To equip students with an understanding of microscopy principles, techniques, and staining methods used in microbiology.
4. To gain the knowledge of sterilization, disinfection, and various physical and chemical methods for microbial control.
5. To impart practical knowledge of pure culture techniques, maintenance, preservation methods in microbiology.

II.Course Outcomes: On completion of this course students will be able to:

1. Describe bacterial cell structure and explain effects of antibiotics on the cell wall.
2. Identify and describe the important features of Photosynthetic bacteria, Myxobacteria, Mycoplasma, Fermentative bacteria, Methanogens, and Halobacteria.
3. Gain insights into various microscopy techniques and apply simple and differential staining in bacterial observation.
4. Comprehend the principles, methods, and applications of sterilization and disinfection.
5. Comprehend methods for isolating and preserving pure cultures, and techniques for cultivating anaerobic and viable non-culturable bacteria.

III.Syllabus of Theory:

Unit 1 Cell organization 9 hrs

1.1 Cell size, shape and arrangement, glycocalyx, capsule, flagella, fimbriae and pili. Cell wall: Composition and detailed structure of Gram-positive and Gram-negative cell walls.

1.2 Cell Membrane: Structure, function and chemical composition of bacterial cell membranes; Differences between eubacteria and archaebacteria;

1.3 Cytoplasm: Ribosomes, mesosomes, inclusion bodies, nucleoid, chromosome and plasmids, Endospore; Effect of antibiotics and enzymes on the cell wall: sphaeroplasts, protoplasts, and L-forms.

Unit 2 Type studies of Bacteria and Archaea 9 hrs

2.1.Salient features of: a) Photosynthetic bacteria - Purple bacteria, Green bacteria and Anabaena b) Gliding bacteria - Myxobacteria

2.2.Salient features of a) Miscellaneous bacteria: Mycoplasma; b) Salient features of

Fermentative bacteria
2.3.Salient features of Extremophiles- a) Methanogens and Halobacteria.

Unit 3 Basics of Microscopy hrs

3.1 Light Microscopy: Bright-Field Microscope- Principle, Components, Operation, resolution and Applications; Principle of Dark-field, Phase contrast and fluorescent microscopes.
3.2 Electron microscope: Principle, Components, resolution and Applications of Scanning and Transmission Electron Microscopes.
3.3 Staining Techniques – Types and properties of dyes; Simple and negative staining; Differential staining techniques- Gram staining, spore staining.
3.4 Unit 4 Sterilization and disinfection techniques- 9 hrs
4.1 Definitions of Sterilization, Disinfection, Antiseptic, Germicide, Sanitizer, Fungicide, Virucide, Bacteriostatic and Bactericidal agent.
4.2 Physical methods of microbial control: Dry heat-Incineration, Hot air oven; Moist heat- Pressure cooker, autoclave; Filter sterilization- laminar air flow, Membrane filter; Radiation methods – UV rays, Gamma rays.
4.3 Chemical methods of microbial control: disinfectants, types and mode of action- alcohols, aldehydes, fumigants, phenols, halogens and heavy metals.
Unit 5 Microbiological techniques 9hrs

5.1 Pure culture isolation: Serial dilution, enrichment culturing technique, plating methods, micromanipulator;
5.2 Maintenance and preservation/stocking of pure cultures: sub culturing, overlaying cultures with mineral oils, lyophilization, sand cultures, storage at low temperature, Culture collection Centers (MTCC, ATCC, DSMZ).
5.3 Cultivation of anaerobic bacteria; Accessing Viable non-culturable bacteria (VNBC).

II. Reference Books:

1. Alcomo, I. E. (2001). *Fundamentals of Microbiology* (6th ed.). Jones and Bartlett Publishers.
2. Beckner, W. M., Kleinsmith, L. J., & Hardin, J. (2000). *The World of Cell* (4th ed.). Benjamin/Cummings.
3. Besty, T., & Koegh, D. C. *Microbiology Demystified*. McGraw-Hill.
4. Black, J. G. (2002). *Microbiology – Principles and Explorations*. John Wiley & Sons Inc., New York.
5. Ghatak, K. L. (2011). *Techniques and Methods in Biology*. PHI Publication.
6. Murphy, D. B. (2001). *Fundamentals of Light Microscopy & Electron Imaging* (1st ed.). Wiley-Liss.

7. Pelczar, M., Chan, E. C. S., & Krieg, N. R. *Microbiology*. Tata McGraw Hill Publishing Co. Ltd., New Delhi.
8. Pranav Kumar. (2016). *Fundamentals and Techniques of Biophysics and Molecular Biology*.
9. Prescott, L. M., Harley, J. P., & Klein, D. A. (2002). *Microbiology* (5th ed.). WCB McGraw-Hill, New York.
10. Stainier, R. V., Ingraham, J. L., Wheelis, M. L., & Painter, P. R. *The Microbial World*. Prentice-Hall of India Pvt. Ltd., New Delhi.
11. Tortora, G. J., Funke, B. R., & Case, C. L. (2004). *Microbiology: An Introduction*. Pearson Education, Singapore.

VI. Co-Curricular Activities:

1. Conduct laboratory workshops that allow students to gain hands- on experience in bacterial culture techniques
2. Competition in performing laboratory techniques like staining
3. Artwork with bacteria or fungi in petridish
4. Quiz in identifying microscopic technique in various micrographs

SEMESTER-I

COURSE 2: PRINCIPLES OF BACTERIOLOGY & MICROBIAL TECHNIQUES

Practical Credits: 1 2 hrs/week

I.Course objectives:

1. To gain practical skills in bacterial isolation, pure culture techniques, and visualization using different microscopy methods.
2. To comprehend and perform basic staining techniques, including Gram, simple, and negative staining, and observe bacterial structures such as motility and capsules.
3. To learn sterilization methods for media and glassware and apply aseptic techniques in microbiological experiments.

II.Laboratory/Field exercises:

1. Isolation of bacteria using Winogradsky column and observation
2. Study of bright field, dark field and phase contrast, Electron microscope micrographs to visualize
3. microbial cells.
4. Simple staining & Negative staining.
5. Gram's staining.
6. Observation of motility and capsule in bacteria
7. Determination of bacterial cell size by the technique Micrometry.
8. Sterilization of medium using Autoclave, Sterilization of glassware using Hot Air Oven.
9. Isolation of pure cultures of bacteria by streaking method.
10. Isolation of bacteria from natural habitat by spread and pour plate method (using serial dilution method)

II SEMESTER

COURSE 3 (Course code: 124403) INTRODUCTION TO MICROBIOLOGY

credits -_3

I. Course Outcomes:

On successful completion of the course, the students will be able to

1. Understand the historical significance of microbiology and the contributions of key scientists.
2. Recognize the classification of microorganisms and their place in the living world.
3. Comprehend the scope and applications of microbiology, including the origin of microbial life and the distinction between eukaryotic and prokaryotic cells.
4. Describe the characteristics of bacteria, archaea, fungi, algae, and protozoa.
5. Describe viruses, including their nature, composition, and diversity in structure.
6. Develop practical skills in aseptic techniques, growth media preparation, isolation methods, and the identification of bacteria and fungi.

Unit - 1: **History of Microbiology** **No. of Hours: 10**

1. Discovery of Microscope and microbial world by Anton von Leeuwenhoek;Aseptic techniques with reference to Charak Samhita, Sushruta Samhita and Ignaz Philipp Semmelweis
2. Golden era of Microbiology- Refutation of abiogenesis; Germ theory of Disease;Discovery of vaccination; Discovery of penicillin
3. Major contributions of Scientists: Edward Jenner, Louis Pasteur, Robert Koch, Joseph Lister, Ivanowsky, Martinus Beijerinck and Sergei Winogradsky

Unit - 2: Place of Microorganisms in the living world **No. ofHours:10**

1. Haeckel's three Kingdom concept, Whittaker's five kingdom concept, three domain concept of Carl Woese
2. Definition and scope of Microbiology; Applications of Microbiology; Diverse groups of Microorganisms
3. Origin of microbial life on earth- Timeline, Miller's Experiment, endosymbiosis (cyanobacteria), distinguishing features of eukaryotic and prokaryotic cell

Unit - 3: Prokaryotic microorganisms and Viruses **No. of Hours:10**

General characteristics of Bacteria(Morphology,metabolic diversityand reproduction)

1. General characteristics of Archaea differentiating them from Bacteria
2. General characteristics of viruses (Nature, composition, size, host specificity,diversity in structure)

Unit - 4: Eukaryotic microorganisms **No. of Hours: 10**

1. Fungi - Habitat, nutrition, vegetative structure and modes of reproduction;
2. Algae- Habitat, thallus organization, photosynthetic pigments, storage forms of food, reproduction.
3. Protozoa–Habitat, cell structure, nutrition, locomotion, excretion, reproduction, encystment.

Unit - 5: Growing Microbes in Lab: Five I's **No. of Hours:05**

1.Inoculation-Aseptic methods of introducing inoculum to growth media; Composition of basic growth media, solid and liquid

2. Incubation and Isolation- Ambient temperature for growth of microorganisms; Concept of Pure culture, mixed culture and contaminated culture

3.Inspection and Identification - Observation of colour, size and shape of colonies; Wet mount and simple staining of bacteria and fungi

III. Skill Outcomes:

1. Implement safety protocols, handling hazardous materials, and practicingpersonal protective measures.
2. Identify microscope parts, adjusting focus and diaphragm, and accuratelyobserving and documenting microscopic images.
3. Prepare smears, identifying different microorganisms, and interpretingmicroscopic characteristics.
4. Analyze electron micrographs, identifying virus types, and describing theirmorphology and size.
5. Operate Autoclave, Hot Air Oven, and Laminar Air Flow Chamber forsterilization and decontamination purposes.

II SEMESTER- PRACTICAL

COURSE 3: INTRODUCTION TO MICROBIOLOGY

credits -_1

1. Good Laboratory Practices and Biosafety
2. Compound Light microscope -Parts and its handling
3. Microscopic observation of bacteria, Algae and Fungi and protozoa
4. Observation of electron micrographs of viruses (Lambda, T4, TMV, HIV, SARS CoV-2, Polio)
5. Laboratory equipment -Working principles of Autoclave, Hot air oven, Laminar airflow chamber

IV.References:

1. Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. (1993). Microbiology. 5th Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi.
2. ·Dube, R.C. and Maheswari, D.K. (2000) General Microbiology. S Chand, New Delhi. Edition), Himalaya Publishing House, Mumbai.
3. Prescott, M.J., Harley, J.P. and Klein, D.A. (2012). Microbiology. 5th Edition, WCB McGraw Hill, New York.
4. Reddy, S.M. and Reddy, S.R. (1998). Microbiology Practical Manual, 3 rd Edition, Sri Padmavathi Publications, Hyderabad.
5. Singh, R.P. (2007). General Microbiology. Kalyani Publishers, New Delhi.
6. Stanier, R.Y., Adelberg, E.A. and Ingram, J.L. (1991). General Microbiology, 5th Ed.,Prentice Hall of India Pvt. Ltd., New Delhi.
7. Jaya Babu (2006). Practical Manual on Microbial Metabolisms and General Microbiology. Kalyani Publishers, New Delhi.
8. Gopal Reddy et al., Laboratory Experiments in Microbiology

IV. Co-Curricular Activities:

1. Establish a Microbiology Club where students can come together to discuss and explore various topics related to microbiology.

2.Organizing microbiology-themed events like microbiology day 3 Poster presentations, oral presentations, and Q&A sessions.

3.Field Trips to Microbiology-related Sites

4.Establish a Microbiology Journal Club where students can review and discuss scientific articles related to microbiology.

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II SEMESTER
COURSE 4: (Course code: 124404) BACTERIOLOGY AND VIROLOGY

credits -_3

Learning Outcomes:

On successful completion of the course, the students will be able to

1. Understand the concept of prokaryotic diversity and taxonomy.
2. Identify and describe the salient features of various bacterial groups
3. Comprehend the discovery, nature, and definition of viruses.
4. Describe the replication processes of specific viruses
5. Comprehend the concept of oncogenic viruses, and role of viruses in the ecosystem.

Unit -1: Bacterial Taxonomy and Ultrastructur No. of Hours: 9

1.Introduction to prokaryotic diversity and taxonomy. Types of classification- Numerical and Phylogenetic

2.Introduction to Bergy's manual of Systematic Bacteriology

3.Non-Culturables and Metagenomics

4.Ultrastructure of a Bacterial Cell-Invariable components -cell wall, Structure and/Functions of cell membrane, cytoplasm, nucleoid; Variable components- plasmid, inclusion bodies, flagella (structure and arrangement), pili, capsule, endospore.

Unit - 2: Type studies of Bacteria and Archae No. of Hours:9

1. Salient features of:

a) Photosynthetic bacteria - Purple bacteria, Green bacteria and *Anabaena*

b) Gliding bacteria - Myxobacteria and Cytophaga group

c) Filamentous -Actinomycetes

d) Spore forming bacteria - Bacillus and Clostridia

e) Miscellaneous - Mycoplasma, Rickettsia, Chlamydia

2. Salient features of Fermentative bacteria, Sulphur bacteria, Nitrogen fixing bacteria
3. Salient features of Extremophiles- Methanogens and halobacteria.

Unit - 3: General Properties and Classification of Viruses No. of Hours:9

1. Discovery of viruses, Nature and definition of viruses, general properties
2. Heirarchy of ICTV nomenclature
3. Outline of Baltimore system of classification.
4. Cultivation of Viruses, Virus Purification and Assay.

Unit - 4: Replication of Viruses No. ofHours:9

1. General features of Viral Replication
2. Replication of T4, lambda, TMV , HIV
3. Replication of Polio, Influenza, Adeno Viruses

Unit - 5: Pathogenic and other Viruse **No. ofHours:**9

1. Defective Viruses- viroids, virusoids, satellite viruses and Prions.
2. Emergence of Viral Pathogens, Introduction to Oncogenic viruses, Concept of Oncogenes and Protooncogenes
3. Role of viruses in Ecosystems; Applications in Biotechnology

III Skill Outcomes:

On successful completion of the course, the students will be able to

1. Develop practical skills in the isolation, identification, and cultivation of bacteria.
2. Acquire knowledge about the preparation of growth media and study host-pathogeninteractions.
3. Gain the ability to examine the bacteria through microscopy.
4. Demonstrate proficiency in isolating bacteria from natural environment

II SEMESTER PRACTICALS
COURSE 4: BACTERIOLOGY AND VIROLOGY

credits -1

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1. Study of bacteria by colony observation and staining-simple, gram
2. Observation of motility and capsule
3. Isolation of bacteria using Winogradsky column and observation
4. Study of viruses (Bacteriophage, TMV and HIV) using micrographs
5. Isolation and enumeration of bacteriophages (PFU) from water/sewagesample using double agar layer technique.
6. Studying isolation and propagation of animal viruses by chick embryo technique.
7. Study of cytopathic effects of viruses using photographs.
8. Perform local lesion technique for assaying plant viruses.

References:

1. Prescott, M.J.,Harley,J.P.andKlein,D.A.Microbiology. 5th Edition WCB McGrawHill, New York, (2002).
2. Tortora, G.J., Funke ,B.R. and Case, C.L. Microbiology : An Introduction. PearsonEducation, Singapore, (2004).
3. Alcomo,I.E.FundamentalsofMicrobiology.VIEdition, JonesandBartlettPublishers.Sudbury.Massachusetts, (2001).
4. BlackJ.G.Microbiology-Principlesand Explorations.JohnWiley&SonsInc.NewYork, (2002).
5. Tom Besty,D.C Jim Koegh.Microbiology Demystified McGRAW-HILL.
6. Christopher Burrell Colin Howard Frederick Murphy. Fenner and White'sMedicalVirology 5th Edition.Academic Press

Co-Curricular Activities:

1. Invite guest speakers, to provide insights into the latest advancements and emerging trends in bacteriology and virology.
2. Conduct laboratory workshops that allow students to gain hands-on experience in bacterial culture techniques
3. Case Study Competitions: Organize case study competitions where students can work in teams to analyze and solve hypothetical cases related to bacteriology and virology
4. Arrange field trips to microbiology research facilities, such as government labs, industrial settings, or healthcare institutions

III SEMESTER, COURSE 5: (Course code: 124405)

EUKARYOTIC MICROORGANISMS

credits -_3

Course Outcomes:

- On successful completion of the course, the students will be able to
- Understand the characteristics, classification, and reproductive mechanisms of fungi, algae, and protozoa.
- Recognize the importance of fungi in biotechnology, including their roles in food production, medicine, and agriculture.
- Comprehend the significance of algae in various industries, the environment, and as a source of food.
- Identify pathogenic protozoa and understand their impact on human health and the environment.

Unit 1: Fungi No. of Hours:9

1. Habitat, distribution, nutritional requirements, fungal cell ultra- structure, fungal wall, Outline classification of Fungi
2. Reproduction in different fungal groups- Phycomycetes, Ascomycetes, Basidiomycetes and Deuteromycetes
3. Heterokaryosi s, heterothallism and parasexual mechanism.
4. Fungal dimorphism (Candida albicans)

Unit 2: Importance of Fungi NO. of Hours:9

1. Role of fungi in biotechnology: food, medicine and pharmaceutical industry (baking, brewing, antibiotics, alcohols, enzymes, organic acids, and pharmaceuticals)
2. Beneficial Role of fungi in Agriculture: Biofertilizers, Myco toxins; Biological control (Myco fungicides, Myco herbicides, Myco insecticides).
3. Mushrooms and its cultivation. (White button, Milky and Oyster)
4. Fungi as plant and animal pathogens (Cercospora, Puccinia, Candida, Aspergillus)

Unit 3: Algae No. of Hours:9

1. Algae- occurrence, thallus organization, algae cell ultra-structure, pigments, flagella, eyespot food reserves, outline classification
2. Vegetative, asexual and sexual reproduction in Algae
3. Photosynthetic apparatus, and outline of Photosynthesis in Algae

Unit 4: Importance & cultivation of Algae No. of Hours:9

1. Importance of algae in agriculture, industry, environment and food with examples.
2. Algal culture techniques- Indoor, Outdoor, Closed, Open, Batch, continuous,Fed batch
3. Culture media and growth parameters for algal cultivation (Spirulina)

Unit 5: Protozoa No. of Hours:9

1. General characteristics with special reference to Amoeba, Paramecium
2. Pathogenic Protozoa- Plasmodium, Leishmania and Giardia

3. Importance of protozoa (in waste management, soil fertility, industry and scientific study)
4. Culturing protozoans from natural sources-Hay water, pond water, Chalkley's solution

5. Haplobiontic (Nemalion), Haplontic (Chlamydomonas), Diplontic (Cladophora), Diplobiontic (Polysiphonia) and Diplohaplontic (Cladophora) life cycles. deleted

I. Skill Outcomes:

On successful completion of the course, the students will be able to

1. Develop practical skills in the isolation, identification, and cultivation of fungi and algae.
2. Acquire knowledge about the preparation of growth media and study host-pathogen interactions.
3. Gain the ability to examine the vegetative and reproductive structures of selected genera through microscopy.
4. Demonstrate proficiency in purifying and preserving pure cultures of common algae and fungi.

III SEMESTER
COURSE 5: - EUKARYOTIC MICROORGANISMS

credits -_1 **PRACTICAL**

1. Preparation of Potato Dextrose Medium.
2 Isolation and identification of pathogenic and non-pathogenic fungi.
3. Study of host-pathogen interaction.
4. Study of the vegetative and reproductive structures of following genera through temporary and permanent slides: *Mucor,Saccharomyces, Penicillium, Agaricus* and *Alternaria*
5. Purification and preservation of pure cultures of common algae and fungi.

References

1. Alexopoulus, C.J., Mims,C.W. and Blackwel, M, Introductory Mycology. John Wiley,New York.
2. Mehrotra, R.S. and K.R.Aneja An Introduction to Mycology. New Age International press, New Delhi
3. Webster, J. Introduction to fungi. Cambridge University Press. Cambridge, U.K. (1985).
4. Bessey E.A. Morphology and Taxonomy of fungi. Vikas Publishing House Pvt. Ltd.,New Delhi.
5. Jhon Webster and R W S Weber. Introduction to Fungi. Cambridge University Press2007.
   A. V. S. S. .Sambamurty. A Textbook of Algae. I.K. International PublishingHouse Pvt.Limited, 2010
6. H.D. Kumar and H.N. Singh.A Textbook on Algae (Macmillan international collegeedition)

Co- Curricular Activities

1. Conduct hands-on microscopy workshops using to observe eukaryotic microorganisms
2. Organize field trips to natural habitats, such as forests, ponds, or marine environments, where eukaryotic microorganisms thrive.
3. Arrange culturing workshops where students can learn how to isolate and culture eukaryotic microorganisms in the laboratory.
4. Eukaryotic Microorganism Photography Contest

II SEMESTER
(Course code: 124406) COURSE 6
BIOMOLECULES AND ENZYMOLOGY

credits - 3

I. Course Outcomes:

On successful completion of the course, the students will be able to

- Understand the classification and properties of carbohydrates, including monosaccharides, disaccharides, polysaccharides, and sugar derivatives.
- Gain knowledge of lipids and fatty acids, including their classification, structures, functions, and their role in cell signaling and metabolism.
- Comprehend the structure and functions of amino acids and proteins, including their primary, secondary, tertiary, and quaternary structures.
- Learn about the structure and functions of nucleic acids, including DNA and RNA, as well as the concept of base composition and nucleic acid- protein interactions. They will also be introduced to the role of vitamins in metabolism.
- Understand the structure of enzymes, enzyme classification, and mechanisms of action. They will also learn about the factors influencing enzyme activity and various types of enzyme inhibition.

UNIT-I: Carbohydrates No. of hours: 9

1. General characters and outline classification of Carbohydrates
2. Monosaccharides- Glucose, fructose, ribose; Stereo isomerism of monosaccharides, epimers, mutarotation and anomers of glucose
3. Disaccharides- concept of reducing and non-reducing sugars;Sucrose, Lactose
4. Polysaccharides- Storage -Starch, glycogen, Structural- Cellulose peptidoglycan and chitin
5. Sugar derivatives- glucosamine.

UNIT-II: Lipids and fatty acids No. ofhours: 9

1. Definition and classification of lipids. Structure and properties of lipids.
2. Importance of lipids in biological systems.
3. Introduction to fatty acids: definition, structure, and nomenclature. Saturated and unsaturated fatty acids.
4. Triglycerides: structure, function, and metabolism. Phospholipids: structure, function, and role in cell membranes. Steroids: structure, biosynthesis, and physiological roles.Waxes: structure, functions, andapplications.

UNIT-III: Amino acids and Proteins. No. of hours:9

1. Biochemical structure and notation of standard protein amino acids
2. General characteristics of amino acids and proteins.
3. Primary, secondary, tertiary and quaternary structures of Protein

4. Non protein amino acids: Gramicidin, beta-alanine, D-alanine andD- glutamic acid.

UNIT-IV: **Nucleic acids and Vitamins No. of hours:9**

1. Structure and functions of DNA and RNA.
2. Base composition. A+T and G+C rich genomes. Basic concept of nucleic acids protein interactions.
3. Concept and types of vitamins and their role in metabolism.

UNIT-V: Enzymes No. of hours: 9

1. Structure of enzyme, Apoenzyme and cofactors, prosthetic group- TPP, coenzyme - NAD, metal cofactors; Definitions of terms – enzyme unit, specific activity and turnover number
2. Classification of enzymes, Mechanism of action of enzymes: active site, transition state complex and activation energy. Lock and key hypothesis, and Induced Fit hypothesis.
3. Effect of pH and temperature on enzyme activity.
4. Inhibition of enzyme activity- competitive, noncompetitive, uncompetitive and allosteric.

III. Skill Outcomes:

On successful completion of the course, the students will be able to

1. Qualitatively Identify mono and disaccharides
2. Qualitatively Identify specific aminoacids
3. Quantitatively estimate DNA
4. Quantitatively estimate protein

III SEMESTER PRACTICALS

COURSE 6: - BIOMOLECULES AND ENZYMOLOGY credits -1

1. Qualitative tests for sugars
2. Qualitative Analysis of Aminoacids.
3. Colorimetric estimation DNA by diphenylamine method.
4. Colorimetric estimation of proteins by Biuret/Lowry method

References:

1. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company Caldwell, D.R. (1995). Microbial Physiology and Metabolism, W.C. Brown Publications,Iowa, USA.
2. Lehninger, A.L., Nelson, D.L. and Cox, M.M. (1993). Principles ofBiochemistry, 2 nd Edition, CBS Publishers and Distributors, New Delhi.
3. Sashidhara Rao, B. and Deshpande, V. (2007). Experimental Biochemistry: A student Companion. I.K. International Pvt. Ltd.
4. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman
5. Voet,D. and Voet J.G (2004) Biochemistry 3rd edition, John Wileyand Sons
6. White, D. (1995). The Physiology and Biochemistry of Prokaryotes,Oxford University Press, New York.

IV. Co-Curricular Activities:

1. Organize Biomolecule Modeling Workshops where students can learn to build physical models or use computer simulations to visualize biomolecules such as proteins, nucleic acids, carbohydrates, and lipids. These workshops can help students understand the three-dimensional structures and interactions of biomolecules, enhancing their comprehension of molecular biology concepts.
2. Assign Biomolecule and Enzyme Case Studies case studies that require students to analyze real-world scenarios related to biomolecules and enzymes in medicine, biotechnology, or environmental science.

III SEMESTER
COURSE 7: MICROBIAL AND ANALYTICAL TECHNIQUES
(Course code: 124407)

credits -_3

Course Outcomes:

On completion of the course, the students will be able to

- Understand the principles and applications of microscopy techniques, including bright field microscopy and electron microscopy (SEM and TEM), as well as staining techniques.
- Know various sterilization and disinfection techniques, including physical methods (dry heat, moist heat, filtration, radiation) and chemical methods (disinfectants, alcohols, aldehydes, fumigants, phenols, halogens, heavy metals).
- Perform pure culture isolation, maintenance and preservation of cultures, cultivation of anaerobic bacteria, and accessing viable non-culturable bacteria (VNBC).
- Understand the principles and applications of spectrophotometry and chromatography techniques, including UV-visible spectrophotometry, colorimetry, turbidometry, paper chromatography, and column chromatography.
- Gain knowledge of centrifugation principles and applications, electrophoretic techniques (agarose and SDS polyacrylamide gel), and the principles and applications of radioisotopes.

Unit -1: Microscopy No. of Hours: 9hrs

1. Microscopy: Principle, mechanism and applications of Bright fieldmicroscope.
2. Principle, mechanism and applications of electron microscope (SEM and TEM). Micrometry.
3. Staining Techniques – Simple, negative and Differential staining techniques (Gram staining, spore staining, Acid fast staining).

Unit-2: Sterilization & Disinfection Techniques No. Of Hours: 9hrs

1. Sterilization, Disinfection, Antiseptic, Germicide, Sanitizer, Fungicide, Virucide, Bacteriostatic and Bactericidal agent.
2. Physical methods of microbial control: Dry heat-Incineration, Hot air oven; Moist heat- Pressure cooker, autoclave; Filter sterilization- laminar air flow, Membrane filter;Radiation methods – UV rays, Gamma rays.
3. Chemical methods of microbial control: disinfectants, types and mode of action-alcohols, aldehydes, fumigants, phenols, halogens and heavy metals.

Unit -3: Microbiological techniques No. of Hours:9hrs

1. Pure culture isolation: Streaking, serial dilution and plating methods, micromanipulator; cultivation.
2. Maintenance and preservation/stocking of pure cultures: sub culturing, overlaying cultures with mineral oils, lyophilization, sand cultures, storage at low temperature, Culture collection centers(MTCC, ATCC, DSMZ);
3. Cultivation of anaerobic bacteria; Accessing Viable non-culturable bacteria (VNBC). Buffers in culture medium. Cultivation of fungi, Actinomycetes, yeasts.

Unit-4: Spectrophotometry & Chromatography No. of Hours: 9

1 Spectroscopy – Principles, laws of light absorption, Instrumentation and applications of UV- visible spectrophotometer. Colorimetry and turbidometry.

2 Chromatography: Principles and applications of paper chromatography (Ascending, Descending and 2-D), Thin layer chromatography.

3 Principle and applications of column chromatography (Partition, adsorption, ion exchange, exclusion and affinity chromatography). Column packing and fraction collection.

Unit - 5: Centrifugation, Electrophoresis & Radioisotopes No. of Hours:9

1 Centrifugation-Principles, types and applications.

2 Electrophoretic technique (agarose and SDS polyacrylamide gel) itsComponents, work

3 Radioisotopes– characters and applications of radioisotopes, principle of autoradiography.

II. Skill Outcomes:

On successful completion of the course, the students will be able to

1. Recognize different microscopy techniques, identify microbial cell structures, interpret micrograph images, and understanding the principles of image contrast.
2. Prepare stained slides, differentiate stained and unstained structures, recognizing staining techniques, and describing the staining characteristics of microbial cells.
3. Perform the staining procedure, distinguishing between Gram-positive and Gram-negative bacteria, recognizing the importance of Gram's staining in bacterial classification, and interpreting Gram-stained slides.
4. Understand sterilization principles, operate autoclave and hot air oven, implement proper sterilization protocols, ensure sterility of media and glassware, and recognize the importance of sterile techniques in microbiology.
5. Understand streaking techniques, perform streak plate method, obtain isolated colonies, recognize contamination, and demonstrate proficiency in maintaining pure cultures for further study.

III SEMESTER PRACTICALS

COURSE 7: MICROBIAL AND ANALYTICAL TECHNIQUES **credits - 1**

1. Study of bright field, dark field and phase contrast, Electron microscope micrographs to visualize microbial cells.
2. Simple staining & Negative staining.
3. Gram's staining.
4. Sterilization of medium using Autoclave, Sterilization of glassware using Hot AirOven.
5. Isolation of pure cultures of bacteria by streaking method.
6. Isolation of bacteria from natural habitat by spread and pour plate method (using serial dilution method)
7. Separation of monosaccharides/amino acids by paper/thinlayer chromatography.
8. Demonstration of column packing in gel filtration chromatography.
9. Determination of absorption max for an aromatic amino acid.
10. Separation of bacterial cells (cell pellet) from broth culture by using a laboratory scale centrifuge.
11. Separation of DNA fragments by Agarose gel electrophoresis.

References:

1. Pelczar M., Chan E.C.S. and Krieg, N.R. Microbiology. Tata Mc Grew HillPublishing Co. Ltd., New Delhi.
2. Stainier R.V., Ingraham, J.L., Wheelis, M.L. and Painter P.R. The Microbial World. Printice-Hall of India (Pvt.) Ltd., New Delhi
3. Wilson& Walker. Principles and Techniques in Practical Biochemistry. 5th EditionCambridge University Press (2000).
4. Murphy D.B. Fundamental of Light Microscopy & Electron Imaging.1st Edition. Wiley Liss. (2001).
5. K L Ghatak. Techniques and Methods In Biology PHI Publication (2011)
6. Pranav Kumar. Fundamentals and Techniques of Biophysics and Molecular Biology(2016)
7. Aurora Blair. Laboratory Techniques & Experiments in Biology.Intelliz Press
8. D.T Plummer. An Introduction to Practical Biochemistry. McGraw Hill Publication1987
9. Beckner, W.M., Kleinsmith L.J and Hardin J. The world of cell. IV editionBenjamin /Cummings (2000)

Co-Curricular Activities:

1. Competition in performing laboratory techniques like staining
2. Artwork with bacteria or fungi in petridish
3. Quiz in identifying microscopic technique in various micrographs

III SEMESTER

COURSE 8: - CELL BIOLOGY AND GENETICS (Course code: 124408)

Unit 1 Hours : 09

1. Cell theory andcell organelles (Mitochondria, Chloroplasts, Lysosomes, Glyoxysomes and Peroxisomes, Golgi apparatus and ER).
2. Cell cycle and its regulation.
3. Cytoskeleton: Structure and organization of actin, myosin and intermediate filaments, microtubules, and their role.

Unit 2 Hours : 09

1. Structure and functions Cell membrane, proton pumps associated (Na-K, Cacalmodulin etc. and their distribution), phagocytosis, pinocytosis, exocytosis.
2. Nuclear envelope, structure of nuclear pore complex, nuclear lamina, transport across nuclear membrane, Nucleolus.
3. Elementary knowledge of development and causes of cancer; Oncogenes and suppressor genes,

Unit 3 Hours : 09

1. Protein sorting and Transport Intracellular signal transduction pathways (GPCR , ERK Pathway, mTOR Signaling)
2. Programmed Cell Death; Stem cells.
3. Specialized chromosomes (polytene, lampbrush)

UNIT 4 Hours : 09

1. Mendalien Genetics , Mono hybrid and Dihybrid cross , Law of dominance segregation and Independent assortment.
2. Chromosome theory of inheritance, Pedigree analysis, Incomplete dominance and co-dominance,
3. Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Allele frequencies, Genotype frequencies.

Unit – 5 Hours : 09

1. Linkage and Crossing over, Molecular mechanism of crossing over. Recombination frequency as a measure of linkage intensity,
2. Hardy-Weinberg Law, role of natural selection, Genetic drift. Speciation
3. Sex determination – Sex linked inheritance, extra chromosomal Inheritance

Course: 8 PRACTICAL

1. Cell counting and Viability
2. Mitosis from onion root tips
3. Meiosis of onion root tips
4. Study of ultrastructure of cell (Plasma membrane, Nucleus, Nuclear Pore Complex, Chloroplast, Mitochondrion, Golgi bodies, Lysosomes, SER and RER)
5. Identification and study of types of cancer, cancer cells by permanent slides/ photographs.
6. Study of Linkage, recombination, gene mapping using marker-based data from Drosophila.
7. Demonstration of DNA fingerprinting.
8. Pedigree chart analysis.

IV SEMESTER, (Course code: 124409)
COURSE 9: - MOLECULAR BIOLOGY AND MICROBIAL GENETICS

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credits -_3

I. Course Outcomes:

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

1. Understand the nature of genetic material, its organization in prokaryotes and eukaryotes, and the role of DNA and RNA.
2. Explain the process of DNA replication in prokaryotes and the involvement of enzymes and factors.
3. Recognize the characteristics, types, and applications of extra chromosomal genetic elements such as plasmids and transposons.
4. Differentiate between classical and modern concepts of genes, understand gene structure, and the process of transcription.
5. Comprehend the genetic code, translation process, and regulation of gene expression in bacteria.
6. Define and classify mutations, understand their molecular basis, and gain knowledge of DNA repair mechanisms.
7. Familiarize with genetic recombination in bacteria,
8. including conjugation, transformation, and transduction processes.

Unit - 1: DNA/RNA as genetic material, Replication of DNA

4. Experimental evidences that established DNA and RNA as genetic material. Genome organization in prokaryotes and eukaryotes.

1 Replication of DNA in prokaryotes.: Bidirectional and unidirectional replication, Semiconservative replication, Proof of Semiconservative replication (Messelson – Stahl Experiment). Mechanism of DNA Replication in Prokaryotes: step by step process, Enzymes and factors involved in replication- Primase, Helicase, Gyrase, DNA polymerases, DNA ligase, SSB proteins.

2 Extra chromosomal genetic elements: General characters, types and applications of Plasmids and transposons.

Unit - 2: Concept of gene, Transcription No. of Hours:9

2.1 Classical Concept of gene: Muton, Recon and Cistron; One gene-one enzyme and one gene - one polypeptide and One gene – One Product hypotheses.

2.2 Modern concept of gene: Definition of gene; Open reading frame; structural, constitutive and regulatory genes; uninterrupted genes, Split genes- concept of introns and exons.

2,3 Protein synthesis in Prokaryotes: Transcription- Definition, difference from replication, promoter, RNA Polymerase, mechanism of transcription. RNA splicing in eukaryotes;

Unit - 3: Translation and regulation of gene expression No. of Hours:9 Protein synthesis in Prokaryotes

1. Genetic code: Salient features, Wobble hypothesis.
2. Translation- Charging of tRNA, aminoacyl tRNA synthetases, Mechanisms of initiation, elongation and termination of polypeptides. Inhibitors of protein synthesis.
3. Regulation of gene expression in bacteria – lac operon.

Unit - 4: Mutations and DNA repair **No. of Hours:9**

1. Mutations: Definition and types of Mutations (Spontaneous and induced, Somatic and germline); Physical and chemical mutagens;
2. Molecular basis of mutations (base pair changes, frame shifts, deletions, inversions, tandem duplications, insertions); Functional mutants (loss and gain of functionmutants); Uses of mutations.
3. Outlines of DNA repair mechanisms: Direct repair, Excision repair, Mismatch Repair, Recombination Repair, SOS Repair.

Unit - 5: Genetic recombination in bacteria **No. of Hours:9**

1. Conjugation - discovery, F-factor, F+ & Hfr, mechanism ofconjugation, applications of conjugation;

2. Transformation- Discovery, mechanism of transformation, Competence Factors affecting transformation and application of transformation.

3. Transduction- discovery, mechanism and types of transduction.

III. Skill Outcomes:

1. performing cell lysis and purification, quantifying DNA, and recognizing the importance of genomic DNA isolation.
2. Estimate DNA using UV Spectrophotometer include preparing DNA samples, measuring absorbance at 260 nm, calculating DNA concentration, and assessing DNA purity.
3. Solve Problems related to DNA and RNA characteristics, Transcription and Translation. 4. Analyze and solve problems related to DNA and RNA structure, understanding transcription and translation processes, and interpreting the impact of mutations on protein synthesis.
4. Prepare gels, loading DNA samples, visualizing DNA bands, analyzing fragment size, and understanding the principles of electrophoresis.
5. Understand Mutagenesis principles, perform UV exposure, assessing mutation frequency, and comprehend the effects of mutations on bacterial phenotypes.

COURSE -9 PRACTICAL

1. Isolation of genomic DNA from E. coli
2. Estimation of DNA using UV spectrophotometer (A260measurement).
3. Problems related to DNA and RNA characteristics, Transcription and Translation.
4. Resolution and visualization of DNA by Agarose Gel Electrophoresis.
5. Problems related to DNA and RNA characteristics, Transcription and Translation.
6. Induction of mutations in bacteria by UV light.
7. Study of different conformations of plasmid DNA through agarose gel electrophoresis.
8. Demonstration of bacterial transformation
9. Instrumentation in molecular biology – Ultra centrifuge, Transilluminator, PCR
10. Study of different types of DNA and RNA using micrographs and model / schematic
11. representations
12. Study of semi-conservative replication of DNA through micrographs / schematic
13. Representations

IV. References Text books:

1. James D. Watson Tania A. Baker, Stephen P. Bell Alexander Gann, Michael Levine, Richard Losick, 2013, Molecular Biology of the Gene, 5th Edition, Pearson Edu Publishers.
2. Roger Y. Stanier, Edward A. Adelberg, John L. Ingraham, 1977, General Microbiology 5th edition, London Macmillan.
3. David Freifelder1986 Molecular Biology 3rd edition, Jones & Bartlett Publishers
4. T.A. Brown, Gene cloning and DNA analysis- An Introduction, 4thedition
5. Bernard R. Glick and Jack. J. Pasternak, Molecular Biotechnology. 3rd edition
6. David Freifelder.Essentials of molecular biology.Jones and Bartlett Publishers, 1998

V. Co-Curricular Activities:

1. Conduct poster presentations, oral presentations, and interactive sessions.
2. Visit laboratories employing molecular biology techniques

IV SEMESTER , (Course code: 1244010)
COURSE 10: - MICROBIAL PHYSIOLOGY AND METABOLISM
credits -_3

I. Course Outcomes:

On successful completion of the course, the students will be able to

1. Understand the nutritional requirements of microorganisms and the different methods of nutrient uptake. They will also gain knowledge of different nutritional groups and types of growth media used for microbial cultivation.
2. Comprehend microbial growth, including the definition of growth, generation time, and the different phases of growth. They will also learn about factors influencing microbial growth and methods for measuring it.
3. Gain knowledge of thermodynamics in biological systems, including concepts of free energy, enthalpy, and entropy. They will also learn about ATP structure and properties, oxidation-reduction reactions, and carbohydrate breakdown pathways.
4. Understand microbial respiration, including aerobic and anaerobic respiration, chemoautotrophy, and fermentative modes.
5. Differentiate the processes of oxygenic and anoxygenic photosynthesis.

UNIT I: Microbial Nutrition **No. of hours: 9**

1. Nutritional requirements of Microorganisms
2. Methods of uptake of nutrients by cells- Primary and secondary active transport, concept of uniport, symport and antiport Group translocation; Iron uptake
3. Nutritional groups of microorganisms-based on C, energy and electron. sources
4. Growth media - synthetic, nonsynthetic, selective, enrichment and differential media.

UNIT II: Microbial Growth No. of hours:9

1. Microbial Growth- Definitions of growth, generation time and specific growth rate; different phases of growth in batch cultures;
2. Synchronous, continuous, biphasic growth.
3. Factors influencing microbial growth
4. Methods for measuring microbial growth - Direct microscopy, viable count estimates, turbidometry and biomass.

UNIT IV: Thermodynamics; Breakdown of Carbohydrates

1. Thermodynamics in biological systems - Concept of free energy, Enthalpy, Standard Free Energy change of reaction, Entropy. First and Second law of Thermodynamics. Open and Closed system.
2. Structure and properties of ATP, Standard Free energy change of hydrolysis of ATP and other high energy compounds. Biological oxidation-reduction reactions. Structure and Function of NAD and FAD.
3. Breakdown of carbohydrates· Glycolytic pathways- EMP, HMP shunt/pentose phosphate pathway and ED; TCA cycle.

UNIT V: Microbial Respiration and Fermentation No.

1. Aerobic respiration - ETS and oxidative phosphorylation

2. Anaerobic respiration, chemoautotrophy - oxidation of inorganic compounds - N, S, Fe and H.
3. Fermentative modes in microorganisms with special reference to alcoholic, Lactic acid fermentations

UNIT V: Bacterial Photosynthesis No. of hours:9

1. Photosynthetic pigments, Photosynthetic apparatus in prokaryotes
2. Outline of oxygenic photosynthesis in bacteria
3. Outline of anoxygenic photosynthesis in bacteria

II. Skill Outcomes:

On successful completion of the course, the students will be able to

1. Understand the impact of temperature and pH on bacterial growth and metabolism.
2. Gain proficiency in colony counting techniques for microbial enumeration.
3. Analyze and interpret growth curve data to understand bacterial growth dynamics.
4. Develop skills in observing and identifying cyanobacteria under the microscope.
5. Apply knowledge of microbial growth factors and techniques to interpret and analyze experimental results.

COURSE 10: - MICROBIAL PHYSIOLOGY AND METABOLISM PRACTICAL

1. Effect of Temperature on bacterial growth 2.Effect of pH on bacterial growth
2. Colony count in Plates
3. Study and plot the growth curve of E. coli by turbidometric and standard plate count methods
4. Observation and identification of permanent slides of cyanobacteria

References:

1. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company Caldwell, D.R. (1995). Microbial Physiology and Metabolism, W.C. Brown Publications,Iowa, USA.
2. Lehninger, A.L., Nelson, D.L. and Cox, M.M. (1993). Principles of Biochemistry, 2 nd Edition, CBS Publishers and Distributors, New Delhi.
3. Sashidhara Rao, B. and Deshpande, V. (2007). Experimental Biochemistry: A student Companion. I.K. International Pvt. Ltd.
4. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman
5. Voet,D. and Voet J.G (2004) Biochemistry 3rd edition, John Wiley and Sons
6. White, D. (1995). The Physiology and Biochemistry of Prokaryotes, Oxford University Press, New York.

IV SEMESTER, (Course code: 1244011)
COURSE 11: r DNA TECHNOLOGY, BIOINFORMATICS AND BIOSTATISTICS

credits -_3

I. Course Outcomes:

On successful completion of the course, the students will be able to

1. Learn the principles and techniques of genetic engineering, including g restriction endonucleases, and DNA transformation.
2. Understand the use of vectors and the basics of polymerase chain reacti also explore the applications of genetic engineering in industry, agr medicine.
3. Gain knowledge of blotting techniques, DNA labeling, DNA sequenc basics of intellectual property rights.
4. Learn about bioinformatic resources, sequence databases, sequence align use of biostatistics in data analysis.
5. Develop skills in measuring central tendency and dispersion, understand types of data, and utilizing biostatistical software for analysis and data pr

UNIT- I: Recombinant DNA Technology

N

o. of Hours: 9

1. Basic principles of genetic engineering. Steps in gene cloning.
2. Restriction endonucleases- applications of Type II restriction enzymes in genetic engineering; DNA polymerases and ligases;Use of linkers and adaptors
3. Vectors – Cosmid , Bacteriophages , BAC, YAC
4. Transformation of DNA by Chemical method, Electroporation.

UNIT- II: Applications of r-DNA technolog

1. **Genomic and C-DNA Libraries, RFLP, RAPD,**
2. Basics of Polymerase chain Reaction
3. Application of genetic engineering in industry, agriculture and medicine, Hybirdoma Technology.

UNIT- III: Techniques in genetic engineering and IPR

1. Blotting Techniques.

2. Labeling of DNA, DNA foot printing.

3. DNA Sequencing-Sanger's method

4. Outlines of Intellectual property Rights (Patents,Trademark,Copyright)

UNIT- IV:Bioinformatics No. of Hours: 9

1. Bioinformatic resources : NCBI, EBI, DDBJ, PUBMED, BIOMED.
2. Sequence Databases – GENBANK, BLAST, FASTA, ExPasy, PDB, NDB, UNIPROT – SWISS PROT.
3. Sequence alignment – Sequence homology, pairwise sequence alignment, automated DNA sequencing, ChIP.

UNIT- V:Biostatistics No. of Hours: 9

1. Measurement of central tendency : MEAN , MEDIAN, MODE.
2. Measurement of dispersion : RANGE, MEANDEVIATION , STANDARD DEVIATION.
3. Use of Biostatistic softwares.
4. Sample and population ; Types of Data , methods of Data presentation.

III. Skill Outcomes: On successful completion of the course, the student will be able to

1. Perform plasmid DNA isolation, agarose gel electrophoresis
2. Understand the principles and applications of DNA fingerprinting for genetic profiling and identification.
3. Utilize nucleic acid and protein databases to access, retrieve, and analyze genetic and protein sequence information
4. Apply sequence alignment algorithms and tools
5. Develop skills using bioinformatics tools and databases

COURSE 11: r DNA TECHNOLOGY, BIOINFORMATICS AND BIOSTATISTICS PRACTICAL

1. Isolation of plasmid DNA by Agarose gel Electrophoresis.
2. Preparation of Recombinant vector by using T4 DNA Ligase.
3. To Understand the concept of DNA fingerprinting by Random Ampilification of Polymorphic DNA.
4. Nucleic acid and protein databases.
5. Sequence alignment
6. Sequence homology and Gene annotation.

References

1. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
2. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley-Blackwell. 3.Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. II Edition. Benjamin Cummings. Crueger W, Crueger A (1990) Biotechnology: A text Book of Industrial Microbiology 2nd edition Sinauer associates,Inc.
3. Demain, A. L and Davies, J. E. (1999). Manual of Industrial Microbiology and Biotechnology, 2nd Edition, ASM Press.
4. Glazer AN and Nikaido H (2007) Microbial Biotechnology, 2nd edition, Cambridge University Press Glick BR, Pasternak JJ, and Patten CL (2010) Molecular Biotechnology 4th edition, ASM Press Gupta PK (2009) Elements of Biotechnology 2nd edition, Rastogi Publications
5. Prescott, Harley and Klein's Microbiology by Willey JM, Sherwood LM, Woolverton CJ (2014), 9th edition, Mc Graw Hill Publishers.
6. Ratledge, C and Kristiansen, B. (2001). Basic Biotechnology, 2nd Edition, Cambridge University Press.
7. Stanbury PF, Whitaker A, Hall SJ (1995) Principles of Fermentation Technology 2nd edition., Elsevier Science
8. Swartz, J. R. (2001). Advances in Escherichia coli production of therapeutic proteins. Current Opinion in Biotechnology, 12, 195–201.

V Co – curricular Activities:

1. Training of students and basic gene cloning methods.
2. Industrial visit on Recombinant products.
3. Prepearation of videos on labeling of DNA and DNA sequencing.
4. Students participation in seminars of the copyright, Patent, Trademark and IPR.
5. Assignments on PCR, Restriction enzymes , vectors , RFLP, RAPD, Hybridoma Technology, Sequence alignment tools of DNA , central tendancy , Data collection and presentation.
6. Conducting group discussion , Quiz, debate in related topics.

Life Sciences – Major Programmes

V SEMESTER

COURSE 12 A: IMMUNOLOGY AND MEDICAL MICROBIOLOGY

Unit - 1: Immune System No. of hours:9

1. Concept of Innate and Adaptive immunity
2. Primary and secondary organs of immune system - thymus, bursa fabricius, bone marrow, spleen, lymph nodes and lymphoid tissues
3. Cells of 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)

SEMESTER-4

COURSE 12 A: IMMUNOLOGY AND MEDICAL MICROBIOLOGY

credits -1

4. Identification of human blood groups. 2. Separate serum from the blood sample (demonstration). 3. Immunodiffusion by Ouchterlony method. 4. Identification of any of the bacteria (E. coli, Pseudomonas, Staphylococcus, Bacillus) using laboratory strains on the basis of cultural, morphological and biochemical characteristics: IMViC, urease production and catalase tests 5. Study of composition and use of important differential media for identification of 6. bacteria: EMB Agar, McConkey agar, Mannitol salt agar, Deoxycholate citrate agar, TCBS Isolation of bacterial flora of skin by 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 (ring worms) 10. Isolation of Normal flora of human body (Hands, Feet, Nostrils, Teeth Surface) by swab method. III

5. 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 /Laboratory 3. Competition on composition and sterile media preparation 4. Competition on Isolation and Identification of bacteria from a sample

V SEMESTER

COURSE 13 A: APPLIED MICROBIOLOGY

credits -3

I. Course Outcomes:

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

1. Identify the areas of entrepreneurship, and assess the scope for establishment.
2. Explain 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,Calocyba indica, Agaricus bisporus, and Volvariella volvaciae; Preparation of compost, filling tray beds, spawning, maintaing optimal temperature, casing, watering, harvesting, storage.
2. Biofertilizers –Chemical fertilizers versus biofertilizers, organic farming. Production of biofertilisers-Rhizobium sp, Azospirillumsp, Azotobactersp.
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

V SEMESTER
COURSE 13 A: APPLIED MICROBIOLOGY
PRACTICAL credits -1

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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 -ByArora.
2. Sathyanarayana.U, Biotechnology.(2005)1stEd.BooksandAllied(P)Ltd.
3. Casida,LEJR,(2019). Industrial Microbiology.NewAge International Publishers
4. K.R.Aneja,ExperimentsinMicrobiology,Plantpathology,Tissueculturean d Mushroom productiontechnology,6thEd.SChandPublication
5. NdukaOkafor.ModernIndustrialMicrobiologyandBiotechnology.2007.CRCPr e s s
6. MichaelJ.Waites,NeilL.Morgan,JohnS.Rockey,GaryHigton.IndustrialMicrobi o l ogy: AnIntroduction.2013.WileyBlackwellPublishers.
7. A.H.Patel.IndustrialMicrobiology.2016.2ndEd.LaxmiPublications,NewDelhi.
8. DubeyRC.ATextbookofBiotechnology.(2014).SChand Publishers.
9. RobertD.Hisrich,MichaelP.Peters,"EntrepreneurshipDevelopment",TataMcG r a w 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

SEMESTER
V SEMESTER
COURSE 14 A: INDUSTRIAL MICROBIOLOGY

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credits -3

Course Outcomes:

By the Completion of the course, the learner should 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 productions
4. Discuss the basic concepts in industrial microbiology, industrially important 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 selection of industrially important 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)

UNITIII: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 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 in small scale (citric acid) and estimate the product

V SEMESTER
COURSE 14 A INDUSTRIAL MICROBIOLOGY
PRACTICAL

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 important 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 related industry
3. Assignments on identifying and procuring industrially important microorganisms

V SEMESTER
COURSE 15 A: FOOD AND DAIRY MICROBIOLOGY

credits -3

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

1. Understand the factors influencing microbial growth, contamination in foods, and sources of microbial contamination.
2. Gain knowledge of 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

Unit1: Microbes in Food and Dairy No. of Hours: 9

1. Intrinsic and extrinsic factors that affect growth and survival of microbes in foods, natural flora and 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 LP system, Immunoglobulins, Lysozyme, Lactoferrin. Food grade Biopreservatives (GRAS), Bacteriocins of lactic acid bacteria; Nisin and other antimicrobials produced by Lactic Acid Bacteria (LAB)

Unit3: Fermented food 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, probiotic foods available in 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 PRACTICAL

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, PF., Principles of Fermentation Technology. Whittaker, A and Hall,
2. S.J 2nd Edition. Pergamon Press (1995).
3. Banwart, GJ. Basic Food Microbiology. CBS Publishers and Distributors, 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.
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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. ModernFo od 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.