YOGI VEMANA UNIVERSITY

Kadapa-516 005, Andhra Pradesh, INDIA

(A State University, Accredited with "A" Grade by NAAC)

Minutes of the BOS meeting in Microbiology

Minutes of the BOS meeting in Microbiology held on Tuesday, 10th October 2023 at 10.30 am in the Seminar Hall (180), Sir CV Raman Science Block, Yogi Vemana University, Kadapa-516 005.

MEMBERS PRESENT

Board of Studies in Microbiology			
S. No.	**Name**	**Designation**	**Address**
1	M. Sreekanth Reddy	Chairman	Lec. in Microbiology, YSR Vivekananda Govt. Degree College, Vempalli
2	P. Subbarami Reddy	Member	Lec. in Microbiology, Govt. Degree College, Pendlimarri
3	Dr. B. Priyadarshini	Member	Lec. in Microbiology, SKR & SKR Govt. Degree College for Women, Kadapa
4	U. Anjaneyulu	Member	Lec. in Microbiology, Sai Parameswara Degree College, Jammalamadugu
5	Prof. D. Vijaya Lakshmi	University Nominee	YV University College, Kadapa

Agenda:

1. Approval of Academic regulations & Standard Operating Procedures (SOP) for 4 years UG Honors program as per NEP-2020
2. Approval of syllabus of B.Sc. Microbiology for 4-year UG honors degree with single major subject.
3. Approval of syllabus of subject specific Skill Enhancement courses for B.Sc. Microbiology, a 4-year UG honors degree with single major subject.
4. Approval of syllabus of Microbiology as minor subject for 4-year UG honors degree with single major subject.

Resolution:

1. It is unanimously resolved to approve Academic regulations & Standard Operating Procedures (SOP) for 4 years UG Honors program with single major subject as per NEP-2020 and to implement from the academic year 2023-24.
2. After thorough discussion, 27 course papers including choice with 84 credits in B.Sc. Microbiology as major subject prepared as per APSCHE curriculum credit frame work was unanimously approved by the BOS.
3. After thorough discussion, 8 subject specific Skill Enhancement course papers including choice with 16 credits in Microbiology prepared as per APSCHE curriculum credit frame work was unanimously approved by the BOS.
4. After thorough discussion, 6 course papers with 24 credits in Microbiology as minor subject prepared as per APSCHE curriculum credit frame work was unanimously approved by the BOS.

SIGNATURES OF THE MEMBERS:

Member	Signature
M. Sreekanth Reddy	
P. Subbarami Reddy	
Dr. B. Priyadarshini	B. Priyadarshini 10/10/2023
U. Anjaneyulu	
Prof. D. Vijaya Lakshmi	10/10/23.

YOGI VEMANA UNIVERSITY: KADAPA

Programme: B.Sc., Honours in MICROBIOLOGY: MAJOR

w.e.f 2023-24 AY

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			
	SEC	19			
		20			
	VIII	21	VII & VIII semester syllabus will be available in due course of time		
		22			
		23			
	SEC	24			
		25			

SEMESTER–1

Course: 1 INTRODUCTION TO CLASSICAL BIOLOGY

Hours/Week:5 Credits:4

Learning objectives:

The student will be able to learn the diversity and classification of living organisms and understand their chemical, cytological, evolutionary and genetic principles.

Learning Out comes

1. Learn the principles of classification and preservation of biodiversity
2. Understand the plant anatomical, physiological and reproductive processes.
3. Knowledge on animal classification, physiology, embryonic development and their economic importance.
4. Outline the cell components, cell processes like cell division, heredity and molecular processes.
5. Comprehend the chemical principles in shaping and driving the macromolecules and life processes.

Unit1: Introduction to Systematics, taxonomy and ecology.

1.1. Systematics– Definition and concept, Taxonomy– Definition and hierarchy.

1.2. Nomenclature– ICBN and ICZN, Binomial and trinomial nomenclature.

1.3. Ecology–Concept of ecosystem, Biodiversity and conservation.

1.4. Pollution and climate change.

Unit2: Essentials of Botany.

2.1. The classification of plant kingdom.

2.2. Plant physiological processes Photosynthesis, Respiration, Transpiration, phyto hormones).

2.3. Structure of flower–Micro and macro sporo genesis, pollination, fertilization and structure of mono and di cot embryos.

2.4 Mushroom cultivation, flori culture and landscaping.

Unit3: Essentials of Zoology

3.1. The classification of Kingdom Animalia and Chordata.

3.2 Animal Physiology–Basics of Organ Systems & their functions, Hormones and Disorders

3.3 Developmental Biology–Basic process of development (Gameto genesis,Fertilization,

Cleavage and Organo genesis)

3.4 Economic Zoology–Seri culture, Apiculture, Aquaculture

Unit4: Cell biology, Genetics and Evolution

4.1. Cell theory,Ultra structure of prokaryotic and eukaryotic cell, cell cycle.

4.2. Chromosomes and heredity –Structure of chromosomes, concept of gene.

4.3. Central Dogma of Molecular Biology.

4.4. Origin of life

Unit5: Essentials of chemistry

5.1. Definition and scope of chemistry, applications of chemistry in daily life.

5.2. Branches of chemistry

5.3. Chemical bonds–ionic, covalent, non covalent– Vander Waals, hydrophobic, hydrogen bonds.

5.4. Green chemistry

References

1. Sharma O.P.,1993. Planttaxonomy.2nd Edition.Mc Graw Hill publishers.

2. PandeyB.P.,2001. The text book of botany Angiosperms.4th edition.S. Chand publishers, New Delhi, India.

3. JordanE.L., Verma P.S.,2018.Chordate Zoology.S. Chand publishers,New Delhi, India.

4. Rastogi, S.C., 2019. Essentials of animal physiology. 4th Edition. New Age International Publishers.

5. Verma P.S., Agarwal V.K., 2006. Cell biology, genetics, Molecular Biology, Evolution and Ecology. S. Chand publishers, New Delhi, India.

6. Sathyanarayana U.,Chakrapani, U.,2013. Biochemistry.4th Edition.Elsevier publishers.

7. JainJ.L.,Sunjay Jain, Nitin Jain, 2000. Fundamentals of Biochemistry. S.Chand publishers, New Delhi, India.

8. Karen Timberlake, William Timberlake, 2019. Basic chemistry. 5th Edition. Pearson publishers.

9. SubrataSenGupta, 2014. Organic chemistry.1st Edition. Oxford publishers.

ACTIVITIES:

1. Make a display chart of life cycle of non flowering plants.

2. Make a display chart of life cycle of flowering plants.

3. Study of stomata

4. Activity to prove that chlorophyll is essential for photosynthesis

5. Study of pollen grains.
6. Observation of pollen germination.
7. Ikebana.
8. Differentiate between edible and poisonous mushrooms.
9. Visit a near by mushroom cultivation unit and know the economics of mushroom cultivation.
10. Draw the Ultra structure of Prokaryotic and Eukaryotic Cell
11. Visit to Zoology Lab and observe different types of preservation of specimens
12. Hands-on experience of various equipment – Microscopes, Centrifuge, pH Meter, Electronic Weighing Balance, Laminar Air Flow
13. Visit to Zoo/ Seri culture / Apiculture/ Aqua culture unit
14. List out different hormonal, genetic and physiological disorders from the society

SEMESTER–1

Course:2 INTRODUCTION TO APPLIED BIOLOGY

Hours/Week:5 Credits:4

Learning objectives

` The student will be able to learn the foundations and principles of microbiology, immunology, biochemistry, biotechnology, analytical tools, quantitative methods, and bio informatics.

Learning Outcomes

1. Learn the history, ultra structure, diversity and importance of microorganisms.
2. Understand the structure and functions of macro molecules.
3. Knowledge on biotechnology principles and its applications in food and medicine.
4. Outline the techniques, tool and their uses in diagnosis and therapy.
5. Demonstrate the bio informatics and statistical tools in comprehending the complex biological data.

Unit1: Essentials of Microbiology and Immunology

1.1. History and Major Milestones of Microbiology; Contributions of Edward Jenner, Louis Pasteur, Robert Koch and Joseph Lister.

1.2. Groups of Microorganisms–Structure and characteristics of Bacteria, Fungi, Archaea and Virus.

1.3. Applications of microorganisms in– Food, Agriculture, Environment, and Industry.

1.4. Immune system–Immunity, types of immunity, cells and organs of immune system.

Unit2: Essentials of Biochemistry

2.1. Biomolecules-I– Carbohydrates, Lipids.

2.2. Biomolecules- II–Amino acids & Proteins.

2.3. Biomolecules- III– Nucleic acids –DNA and RNA.

2.4. Basics of Metabolism– Anabolism and catabolism.

Unit3: Essentials of Biotechnology

3.1. History, scope, and significance of biotechnology. Applications of biotechnology in Plant, Animal, Industrial and Pharmaceutical sciences.

3.2. Environmental Biotechnology – Bio remediation and Bio-fuels, Bio-fertilizers and Bio-pesticides.

3.3. Genetic engineering – Gene manipulation using restriction enzymes and cloning vectors; Physical, chemical, and biological methods of gene transfer.

3.4. Transgenic plants – Stress tolerant plants (biotic stress – BT cotton, a biotic stress – salt tolerance). Transgenic animals– Animal and disease models.

Unit4: Analytical Tools and techniques in biology–Applications

4.1. Applications in forensics–PCR and DNA fingerprinting

4.2. Immunological techniques– Immuno blotting and ELISA.

4.3. Monoclonal antibodies–Applications in diagnosis and therapy.

4.4. Eugenics and Gene therapy

Unit5: Bio statistics and Bio informatics

5.1. Data collection and sampling. Measures of central tendency –Mean, Median, Mode.

5.2. Measures of dispersion – range, standard deviation and variance. Probability and tests of significance.

5.3. Introduction,Genomics,Proterozoic,types of Biological data, biological data bases-NCBI, EBI, Gen-Bank; Protein 3Dstructures, Sequence alignment

5.4. Accessing Nucleic Acid and Protein data bases, NCBI Genome Work bench

REFERENCES

1. GerardJ.,Tortora, BerdellR. Funke, ChristineL. Case., 2016. Microbiology: An Introduction.11thEdition. Pearson publications, London, England.

2. Micale,J.PelczarJr.,E.C.S.Chan.,NoelR.Kraig.,2002.PelczarMicrobiology.5th Edition. Mc Graw Education, New York, USA.

3. Sathyanarayana U.,Chakrapani, U.,2013. Biochemistry.4thEdition.Else vierpublishers.

4. JainJ.L.,SunjayJain, NitinJain, 2000. Fundamentals of Biochemistry. S. Chand publishers, New Delhi, India.

5. R.C.Dubey,2014.Advanced Biotechnology.S. Chand Publishers, New Delhi, India.

6. Colin Ratledge, Bjorn, Kristiansen, 2008. Basic Biotechnology. 3rd Edition. Cambridge Publishers.

7. U. Sathyanarayana, 2005. Biotechnology. 1st Edition. Books and Allied Publishers pvt.ltd., Kolkata.

8. Upadhyay,UpadhyayandNath. 2016. Biophysical Chemistry, Principles and Techniques. Himalaya Publishing House.

9. Arthur M. Lesk. Introduction to Bio informatics.5th Edition. Oxford publishers.

10. A.P Kulkarni, 2020. Basics of Bio statistics. 2ndEdition. CBS publishers.

ACTIVITIES

1. Identification of given organism as harm full or beneficial.
2. Observation of microorganisms from house dust under microscope.
3. Finding microorganism from pond water.
4. Visit to a microbiology industry or biotech company.
5. Visit to a waste water treatment plant.
6. Retrieving a DNA or protein sequence of a gene'

7. Performing a BLAST analysis for DNA and protein.
8. Problems on bio statistics.
9. Field trip and awareness programs on environmental pollution by different types of wastes and hazardous materials.
10. Demonstration on basic biotechnology lab equipment.
11. Preparation of 3 D models of genetic engineering techniques.
12. Preparation of 3D models of transgenic plants and animals.

[**NOTE**: In the colleges where the resis availability of faculty for microbiology and biotechnology, those chapters need to be handled by microbiology and biotechnology faculty. In other colleges, the above topics shall be dealt by Botany and Zoology faculty]

II- SEMESTER

COURSE 3:-INTRODUCTION TO MICROBIOLOGY

Credits-3

1. **Course Out comes**:

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 microorganism and Microscope and microbial world by Antonvon Leeuwenhoek; Aseptic techniques with reference to Charak Samhita, Sushruta Samhita and Ignaz Philipp Semmel weis
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, LouisPasteur, Robert Koch, Joseph Lister, Ivanowsky, Martinus Beijerinck and Sergei Winogradsky

Unit-2: -MICROBIAL TAXONOMY **No. of Hours: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. ofHours:10**

1. General characteristics of Bacteria (Morphology, metabolic diversity and reproduction)
2. General characteristics of Archaea and cynobacteria differentiating them from Bacteria

3. 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: Cultivation of microorganisms **No. of Hours: 05**

1. Inoculation-Aseptic methods of introducing inoculums to growth media; Composition of basic media, solid and liquid
2. Incubation and Isolation- Optimum conditions for growth of microorganisms ;Concept of Pure culture, mixed culture and Contamination of morphology and culture characteristics
3. Inspection and Identification-Observation of color, size and shape of colonies; staining Techniques of bacteria and lacto phenol cotton blue mount of fungi

III. Skill Out comes:

1. Implement safety protocols, handling hazardous materials, and practicing personal protective measures.
2. Identify microscopic parts, adjusting focus and diaphragm, and accurately observing and documenting microscopic images.
3. Preparation of smears, identification of morphological different microorganisms by staining methods and interpreting microscopic characteristics.
4. Analyze electron micrographs, identifying virus types, and describing their morphology and size.
5. Handling of Autoclave, Hot Air Oven, and Laminar Air Flow Chamber for sterilization and decontamination purposes.

II- SEMESTER

COURSE 3:-INTRODUCTION TO MICROBIOLOGY

Credits-_1

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1. Good Laboratory Practices and Bio-safety
2. Compound Light microscope-Parts and its handling
3. Microscopic observation of bacteria,(SIMPLE GRAM STAINING TECHNIQUE) Algae and Fungi and protozoa
4. Observation of electron micrographs of viruses (Lambda, T4, TMV, HIV, SARSCoV-2,Polio)
5. Laboratory equipment -Working principles of Autoclave, Hot air oven, Laminar air flow chamber

IV. References:

1. Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. (1993). Microbiology. 5thEdition,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. 5thEdition,WCB Mc Graw 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.andIngram,J.L.(1991).GeneralMicrobiology,5thEd.,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

V. 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.

4. Field Trips to Microbiology-related Sites

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

IISEMESTER

COURSE 4:-BACTERIOLOGY AND VIROLOGY

Credits-3

I. Learning Outcomes:

On success full 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 Ultra structure No. of Hours: 9

1. Introduction to prokaryotic, Microorganisms) and taxonomy. Types of classification-Numerical and Phylogenetic analysis.
2. Introduction to Bergy's manual of Systematic Bacteriology
3. UnCulturables and Meta genomics
4. Ultra structure of a Bacterial Cell-Invariable components-cell wall, Structure and/ Functions of cell membrane, cytoplasm, nucleoide; 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) Photo synthetic bacteria- Purple bacteria, Green bacteria and ***Cyanobacteria***

b) Gliding bacteria-Mycobacterium and Cytophaga group

c) Filamentous-Actinomycetes

d) Spore forming bacteria-Bacillus and Clostridia

e) Mycoplasma, Rickettsia, Chlamydia

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

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

1. Discovery and general characteristics, Structure of viruses,
2. Types of Viruses (DNA.RNA VIRUS)
3. Heirarchy of ICTV nomenclature and Outline of Baltimore system of classification.
4. Isolation and Cultivation of Viruses, Virus Purification and Assay.

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

1. General features of Viral Replication (Lytic and lysogenic cycles)
2. Life cycle of TMV
3. Replication of HIV
4. Life cycle of Adeno Viruses

Unit-5: other Viruses **No. of Hours:**9

1. Defective Viruses- viroids, virusoids, satellite viruses and Prions.
2. Introduction to Oncogenic viruses, Concept of Oncogenes and Proto onco genes
3. viruses in Ecosystems;

III. **Skill Outcomes:**

On success full 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-pathogen interactions.
3. Gain the ability to examine the bacteria through microscopy.
4. Demonstrate proficiency in isolating bacteria from natural environment
5. Cultivation and isolation of viruses

II SEMESTER

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 Hanging drop method and capsule
3. Isolation of bacteria ,Algae and fungi using Winogradsky column and observation
4. Study of viruses (Bacteriophages, TMV and HIV) using micrographs
5. Isolation and enumeration of bacteriophages (PFU) from water/sewage sample using double agar layer technique.
6. Studying isolation and propagation of animal viruses by chick embronated egg inoculation method.
7. Study of cytopathic effects of Plant viruses using photographs.
8. Perform local lesion technique for detection of plant viruses.

References:

1. Prescott, M.J.,Harley, J.P. and Klein, D.A. Microbiology. 5th Edition WCB McGraw Hill, New York,(2002).
2. Tortora, G.J., Funke , B. R. and Case, C.L. Microbiology : An Introduction. Pearson Education, Singapore, (2004).
3. Alcomo,I.E. Fundamentals of Microbiology. VIEdition, Jones and Bartlett Publishers. Sudbury. Massachusetts, (2001).
4. BlackJ.G.Microbiology- Principles and Explorations. JohnWiley & Sons Inc. New York, (2002).
5. Tom Besty, D. C Jim Koegh. Microbiology Demystified Mc GRAW-HILL.
6. Christopher Burrell Colin Howard Frederick Murphy. Fennerand White's Medical Virology 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 health care institutions Field visit to crops

III- SEMESTER

COURSE 5:-EUKARYOTIC MICROORGANISMS

Credits-_3

I. Course Outcomes:

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

1. Understand the characteristics, classification, and reproductive mechanism of fungi, algae, and protozoa.
2. Recognize the importance of fungi in biotechnology, including theirrolesin food production, medicine, and agriculture.
3. Comprehend the significance of algae in various industries, the environment, and as a source of food.
4. Identify pathogenic protozoa and understand their impact on humanhealthand the environment.

Unit1: Fungi **No. of Hours:9**

1. Habitat, distribution, nutritional requirements, fungal cell ultra-structure, fungal cell wall, fungal classification.
2. Reproduction in- Phycomycetes, Ascomycetes, Basidiomycetes and Deuterokaryosis Heterokaryosis, heterothallism and parasexual mechanism.
3. Fungal dimorphism (Candidaalbicans)

Unit2: 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, Mycoinsecticides).
3. Mushrooms and its cultivation. And applications (Whitebutton, Milky and Oyster)
4. Fungal pathogens (Cercospora, Puccinia, Candida, Aspergillus)

Unit3: Algae **No. of Hours:9**

1. Algae general charactistics, thallus organization, algae cell ultra-structure, pigments, flagella, eyespot food reserves, outline classification
2. Reproduction in Algae
3. Photosynthetic mechanism in algae,

Unit4: Importance and cultivation of Algae **No. of Hours:9**

1. Economic Importance of algae in agriculture, industry, environment and food with examples.

2. Algal culture techniques- Batch, continuous,

3. Media and growth parameters of fungal cultivation (Spirulina)

Unit5: Protozoa **No. of Hours:9**

1. General characteristics with special reference to Amoeba, Paramecium
2. Pathogenic Protozoa NS-Plasmodium, Leishmania and Giardia
3. Importance of protozoa (in waste management, soil fertility, industry and scientific study)
4. Culturing protozoans from natural sources- Haywater, pondwater, Chalkley'ssolution
5. Haplobiontic (Nemalion), Haplontic (Chlamydomonas), Diplontic (Cladophora), Diplobiontic (Polysiphonia) and Diplohaplontic (Cladophora) life cycles. deleted

II. 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

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a. Preparation of Potato Dextrose Medium.

b. Isolation and identification of pathogenic and non-pathogenic fungi.

c. Study of host-pathogen interaction.

d. Study of the vegetative and reproductive structures of following genera through temporary and permanent slides: *Mucor, Saccharomyces, Penicillium, Agaricus* and *Alternaria*

e. Purification and preservation of pure cultures of common algae and fungi.

References

1. Alexopoulus, C.J., Mims,C.W. and Blackwel, M, Introductory Mycology. JohnWiley, NewYork.
2. Mehrotra, R.S. and K.R.Aneja An Introduction to Mycology. New AgeInternational 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. CambridgeUniversityPress2007.
6. A. V. S. S. Sambamurty. A Textbook of Algae. I.K. International Publishing House Pvt. Limited,2010
7. H.D. Kumar and H.N. Singh.A Textbook on Algae (Macmillan international college edition)

III. 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

III SEMESTER

COURSE 6:-BIOMOLECULES AND ENZYMOLOGY

Credits-_3

I. Course Outcomes:

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

1. Understand the classification and properties of carbohydrates, including mono saccharides, disaccharides, polysaccharides, and sugar derivatives.
2. Gain knowledge of lipids and fatty acids, including their classification, structures, functions, and their role in cell signaling and metabolism.
3. Comprehend the structure and functions of amino acids and proteins, including their primary, secondary, tertiary, and quaternary structures.
4. Learn about the structure and functions of nucleic acids, including DNA and RNA, as well as the concept of base composition and nucleic acid-proteininteractions.Theywillalsobeintroducedtotheroleofvitaminsinmetabolism.
5. 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. Mono saccharides- Glucose, fructose, ribose; Stereo isomerism of mono saccharides, epimers, mutarotation and ananciomers 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. of hours: 9**

1. Definition and classification of lipids. Structure and properties of lipids. Importance of lipids in biological systems.
2. Introduction to fatty acids: definition, structure, and nomenclature. Saturated and unsaturated fatty acids. Oxidation.
3. Triglycerides: structure, function, and metabolism.

Phospholipids: structure, function, and role in cell membranes. Steroids: structure, functions biosynthesis, and physiological roles. Waxes: structure, functions, and applications.

UNIT-III: Amino acids and Proteins. **No.ofhours:9**

1. Biochemical structure and notation of standard protein amino acids General characteristics of amino acids and proteins.
2. Primary, secondary, tertiary and quaternary structures of Protein
3. Non protein amino acids: Gramicidin, beta-alanine, D-alanine and D-glutamicacid.

UNIT-IV: **Nucleic acids and Vitamins** **No. ofhours: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. Types of nucleic acids.
3. Types and structure and functions of vitamins and their role in metabolism.

UNIT-V: Enzymes **No. ofhours:9**

1. Structure of enzyme, Apo enzyme 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 site.

III. Skill Outcomes:

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

1. Qualitatively Identify mono and disaccharides, Poly saccharides
2. Qualitatively Identify specific amino acids
3. Estimation of DNA
4. Estimation of protein

III SEMESTER

COURSE 6:-BIOMOLECULES AND ENZYMOLOGY

credits-1

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1. Qualitative tests for carbohydrates (MONO,DI,POLY SACCHARIDES)
2. Qualitative analysis of Amino acids.
3. Colorimetric estimation DNA by diphenyl amine method.
4. Colorimetric estimation of proteins by Biuret/ Lowry method
5. Estimation of salivary amylase
6. Estimation of RNA by orcinol method

IV. 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, 2nd 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 shortcourse,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.

V. Co-Curricular Activities:

1. Organize Biomolecule Modeling Workshops where students can learn to build physical models or use computer simulations and 3 D model 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: MICROBIOLOGICAL AND ANALYTICAL TECHNIQUES

Credits-3

I. Course Outcomes:

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

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

Unit-1: Microscopic Techniques **No. of Hours: 9 hrs**

1 Microscopy: Principle, mechanism and applications of Dark field, Bright field microscope.

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 and disinfection techniques No.of Hours: 9hrs

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

Unit-3: Microbiological techniques **No.ofHours:9hrs**

1 Pure culture techniques: Streaking, serial dilution and plating methods, micro manipulator;

2. Preservation, maintenance and revival of the culture (Long term and short term): 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 Techniques **No. ofHours: 9**

1 Spectroscopy; Principles, laws of light absorption, Instrumentation and applications of UV-visible spectrophotometer. Colorimetre and turbidometre.

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

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

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

1 Centrifugation- Principles, types and applications.

2 Electrophoresis technique (agarose and SDS polyacrylamide gel) its Components,working principle and applications

3 Radioisotopes– Types and applications of radio isotopes, Principle of auto radiography.

II. Skill Outcomes:

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

1. Recognize different microscopic 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 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 sterilization 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

COURSE 7: MICROBIOLOGICAL AND ANALYTICAL TECHNIQUES

credits-_1

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1. Study of bright field, dark field and phase contrast, Electron microscope micro graphs to visualize microbial cells.
2. Simple staining & Negative staining.
3. Gram'sstaining.
4. Sterilization of medium using Autoclave, Sterilization of glassware using Hot Air Oven.
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 mono saccharides/amino acids by paper /thin layer 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 gelelectrophoresis.

V.References:

1. Pelczar M., Chan E.C.S. and Krieg, N.R. Microbiology. Tata Mc Grew Hill Publishing Co. Ltd., NewDelhi.
2. Stainier R.V., Ingraham, J.L., Wheelis, M.L. and Painter P.R. The Microbial World.Printice HallofIndia(Pvt.) Ltd., NewDelhi
3. Wilson& Walker. Principles and Techniques in Practical B i o c h e m i s t r y . 5thEditionCambridgeUniversity Press (2000).
4. Murphy D.B. Fundamental of Light Microscopy & Electron Imaging.1st Edition.WileyLiss. (2001).
5. KLGhatak.Techniques andMethodsInBiologyPHIPublication(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 edition Benjamin/Cummings (2000)

VI. Co-Curricular Activities:

1. Competition in performing laboratory techniques like staining
2. Art work with bacteria or fungi inpetridish
3. Quiz in identifying microscopic technique in various micro graphs

IIISEMESTER

COURSE 8:- CELL BIOLOGYAND GENETICS

Credits-_3

I. Course Outcomes:

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

1. Understand cell theory, cell organelles, the cell cycle, and the role of the cytoskeleton.
2. Students will comprehend the structure and functions of the cell membrane,nuclear envelope, and nucleolus, as well as gain basic knowledge of cancer development.
3. Learn about protein sorting, intra cellular signal transduction pathways, programmed cell death,stem cells, and specialized chromosomes.
4. Gain knowledge of Mendelian genetics, including mono-hybrid and dihy brid crosses, inheritance patterns, and allele frequencies.
5. Understand the concepts of linkage, crossing over, the Hardy-Weinberg Law,natural selection, genetic drift, and the mechanisms of sex determination and inheritance.

Unit 1: **No.of Hours :09**

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

Unit 2: **NO.Of. Hours : 09**

1. Structure and functions Cell membrane, proton pumps associated (Na-K, Ca calmodulin 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: **No.of. Hours : 09**

1. Protein sorting and Transport Intracellular signal transduction pathways (GPCR ,ERK Pathway, m TOR Signaling)
2. Programmed Cell Death; Stem cells.

3. Specialized chromosomes (polytene,lampbrush)

UNIT 4: **No.of.Hours : 09**

1. Mendelian 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 **No.of.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. Sexd etermination–Sex link ed inheritance, extra chromosomal Inheritance

Skill Outcomes:

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

1. Develop proficiency in cell counting and viability assessment techniques.
2. Observe and analyze mitosis and meiosis in onion root tips, understanding their stages and significance.
3. Identify and analyze the ultra structure of cells through electron micro graphs.
4. Recognize and interpretcancer cells through permanent slides or photographs.
5. Understand genetic concepts like linkage, recombination, gene mapping, DNA finger printing, and pedigree chart analysis

III SEMESTER

COURSE 8:-CELL BIOLOGY AND GENETICS

credits-_1

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1. Viable Cell counting
2. Mitosis from onion roottips
3. Meiosis of onion flower bud
4. Study of ultra structure 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 finger printing.
8. Pedigree chart analysis.

III. References:

1. A.J.F Griffiths, S. R Wessler, S. B Carroll & J. Doebley, An Introduction to Genetic Analysis,.10th Ed., W.H. Freeman& Company (New York) 2010
2. Geoffrey M.Cooper and Robert E.Hausman-Thecellamolecularapproach.
3. Bruce Alberts ,Rebecca Heald,et al. Molecular Biology Of The Cell
4. Arnold Berk(Author),ChrisA. Kaiser (Author), Harvey Lodish (Author), Angelika Amon (Author), Molecular Cell Biology.
5. Benjamin Lewin Genes
6. Eldon John Gardner,MichaelJ. Simmons,D. PeterSnustad Principlesof Genetics
7. Karp G, John Wiley Cell Biology
8. JaneB.Reece(Author),MarthaR.Taylor(Author),Eric J. Simon (Author),JeanL. Dickey , Campbell Biology:Concepts and Connections
9. Veer Bala Rastogi, Genetics BD Singh, Genetics

IV. Co-Curricular Activities:

1. Laboratory demonstrations where students can observe and participate in various experiments related to cell biology and genetics.
2. Guest Lectures: Invite experts and professionals from the field of cell biology and genetics to deliver guest lectures. They can share their research, industry experiences,and advancements in the field, providing students with valuable insights and exposure to real-

world applications.

3. Seminars and Workshops on emerging areas, such as gene editing technologies, stem cell research, or personalized medicine
4. Research Project on literature reviews,designing experiments,and analyzing data.
5. Science Outreach Programs: Giving presentations at local schools, or creating educational materials

IV SEMESTER

COURSE9:-MOLECULAR BIOLOGY AND MICROBIAL GENETICS

credits-_3

I. CourseOutcomes:

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, including conjugation, transformation, and transduction processes.

Unit-1:DNA/RNA as genetic material, Replication of DNA No. Of.Hours:9

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

1.2 Replication of DNA in prokaryotes.: Bidirectional and unidirectional replication,Semi conservative replication, Proof of Semi conservative 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.

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

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

2.1 Classical Concept of gene over lapping genes and split gene: Muton, Recon and Cistron; One gene-one enzyme and one gene-one poly peptide and One gene– One Product hypotheses.

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

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

Unit - 3: Translation and regulation of gene expression **No. of Hours:9**

3.1 Protein synthesis in Prokaryotes

3.2 Genetic code:Salient features,Wobble hypothesis.

3.1 Translation- Charging of tRNA, amino acyl tRNA synthetases, Mechanisms of initiation, elongation and termination of poly peptides.Inhibitors of protein synthesis.

3.2 Regulation of gene expression in bacteria – lac operon.

Unit-4: Mutations and DNA repair No. ofHours:9

4.1 Mutations: Definition and types of Mutations (Spontaneous and induced, Somatic and germline); Physical and chemical mutagens;

4.2 Molecular basis of mutations (base pair changes,frame shifts, deletions, inversions, tandem duplications, insertions); Functional mutants (loss and gain of function mutants); Uses of mutations.

4.3 Out lines of DNA repair mechanisms: Direct repair, Excision repair, Mis match Repair,Recombination and SOS Repair.

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

5.1 Conjugation- discovery, F-factor, F+ & SRAINS, mechanism of conjugation, applications of conjugation;

5.2Transformation- Discovery, mechanism of transformation, Competence Factors affecting transformation and application of transformation.

5.3 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 Spectro photometer 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.
5. Prepare gels, loading DNA samples, visualizing DNA bands, analyzing fragment size,and understanding the principles of electrophoresis.
6. Understand Mutagenesis principles, perform UV exposure, assessing mutation frequency, and comprehend the effects of mutations on bacterial pheno types.

IV SEMESTER

COURSE 9:-MOLECULAR BIOLOGY AND MICROBIAL GENETICS

credits-1

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1. Isolation of genomic DNA from *E.coli*
2. Estimation of DNA using UV spectrophoto meter DPA, ORCINOL
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 trans formation
9. Instrumentation in molecular biology–Ultra centrifuge, Transilluminator, PCR
10. Study of different types of DNA and RNA using micro graphs and model/schematic representations
11. Study of semi-conservative replication of DNA through micro graphs/schematic representations

III. References

Textbooks:

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. RogerY.Stanier,EdwardA.Adelberg,JohnL.Ingraham,1977,GeneralMicr obiology5th edition, London Macmillan.

3. DavidFreifelder1986MolecularBiology3rdedition, Jones& Bartlett Publishers
4. T.A.Brown,Gene cloning and DNA analysis-An Introduction,4th edition
5. BernardR.GlickandJack.J.Pasternak, MolecularBiotechnology.3rd edition
6. David Freifelder.Essentials of molecular biology.Jones and Bartlett Publishers,1998

IV. Co- CurricularActivities:

1.Conduct poster presentations,oral presentations,and interactive sessions.

2. Visit laboratories employing molecular biology techniques

IV SEMESTER

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 break down pathways.
4. Understand microbial respiration, including aerobic and anaerobic respiration, chemo autotrophy, and fermentative modes.
5. Differentiate the processes of oxygenic and anoxygenic photo synthesis.

UNIT: 1: Microbial Nutrition No. ofhours:9

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

UNIT: 2. Microbial Growth No. ofhours: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 (PH,TEMPERATURE,OXYGEN PHYSICAL AND CHEMICAL)
4. Methods for measuring microbial growth - Direct microscopy, viable count estimates,turbidometry and biomass.

UNIT:3. Thermodynamics; Breakdown of Carbohydrates No.ofhours:9

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. carbohydrate Metabolism· Glycolytic pathways- EMP, HMP shunt/pentose phosphate pathway and ED; TCA cycle.Sangers methods.

UNIT:4. Microbial Respiration and Fermentation No.ofhours: 9

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:5. Bacterial Photosynthesis No. ofhours:9

1. Photo synthetic pigments, Photosynthetic apparatus in prokaryotes
2. Outline of oxygenic photo synthesis in bacteria
3. Out line 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.

IVSEMESTER

COURSE 10:-MICROBIALPHYSIOLOGY AND METABOLISM

credits-1

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

IV References:

1. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman andCompany 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, 2ndEdition, 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.andVoet J.G(2004)Biochemistry3rdedition, John Wiley and Sons
6. White, D. (1995). The Physiology and Biochemistry of Prokaryotes, Oxford UniversityPress, New York.

V Co-Curricular Activities:

1. Assignments in nutrient utilization, energy production, metabolic pathways,
2. Students can study microbial growth curves, metabolic pathways,or physiological responses to environmental factors.
3. Organize seminars where students can deliver presentations on specific topics in microbial physiology and metabolism.
4. Create visual representations of microbial metabolic pathways.

IVSEMESTER

COURSE11:rDNA 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 restriction endo nucleases, and DNA transformation.
2. Understand the use of vectors and the basics of polymerase chain reaction also explore the applications of genetic engineering in industry, agriculture and medicine.
3. Gain knowledge of blotting techniques, DNA labeling, DNA sequenc basics of intellectual property rights.
4. Learn about bioinformatic resources, sequence data bases, sequence alin 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 prediction.

UNIT-I:Recombinant DNATechnology No. ofHours: 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–PLASMIDS ,Cosmid, Bacteriophages, BAC,YAC
4. Transformation of DNA by Chemical method, Electroporation.

UNIT-II: Applications of r-DNA technology No. ofHours: 9

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

UNIT-III:Techniques in genetic engineering and IPR No. ofHours: 9

1. Blotting Techniques.
2. Labeling of DNA, DNA foot printing.
3. DNA Sequencing- Sanger'smethod
4. Outlines of Intellectual property Rights (Patents,Trademark,Copyright)

UNIT-IV:Bioinformatics No. ofHours: 9

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

UNIT-V: Biostatistics **No. ofHours: 9**

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

III. SkillOutcomes:On successfulcompletion ofthecourse,thestudentwill beable to

1. Performplasmid DNAisolation, agarosegel electrophoresis
2. UnderstandtheprinciplesandapplicationsofDNAfingerprintingforgeneticprofilingandidentification.
3. Utilizenucleicacidandproteindatabasestoaccess,retrieve,andanalyzegeneticandproteinsequence information
4. Applysequencealignment algorithmsand tools
5. Developskillsusingbioinformaticstoolsanddatabases

IV SEMESTER

COURSE11:rDNA TECHNOLOGY, BIOINFORMATICS AND BIOSTATISTICS

credits-1

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1. Isolation of plasmid DNA Of E,Coli by Agarose gel Electrophoresis.
2. Preparation of Recombinant vect or by usingT4DNA Ligase.
3. To Understand the concept of DNA finger printing by Random Ampilification of Polymorphic DNA.
4. Nucleic acid and protein databases.
5. Sequence alignment
6. Sequence homology and Geneannotation.

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.CampbellA.M.,HeyerL.J. (2006) DiscoveringGenomics, ProteomicsandBioinformatics. IIEdition.BenjaminCummings.CruegerW,Crueger A(1990)
   Biotechnology: A text Book of Industrial Microbiology 2nd edition Sinauerassociates,Inc.
3. Demain, A. Land 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, CambridgeUniversity Press Glick BR, Pasternak JJ, and Patten CL (2010) Molecular Biotechnology 4th edition, ASM Press Gupta P K (2009) Elements of Biotechnology 2nd edition, Rastogi Publications
5. Prescott, Harley and Klein's Microbiology by Willey JM, Sherwood LM, WoolvertonCJ(2014), 9th edition, McGraw Hill Publishers.
6. Ratledge,CandKristiansen,B.(2001).Basic Biotechnology, 2nd Edition, Cambridge University Press.
7. Stanbury P F, Whitaker A, Hall S J (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–curricularActivities:

1. Training of students and basic gene cloning methods.

2. Industrial visit on Recombinant products.
3. Prepearation of videoson 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, HybridomaTechnology,SequencealignmenttoolsofDNA,centraltendancy,Datacollectionand presentation.
6. Conducting group discussion, Quiz, debate in related topics.

V SEMESTER

COURSE 12A: IMMUNOLOGY AND MEDICAL MICROBIOLOGY

credits-3

I. Course outcomes:

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

1. Describe the key concepts in Immunology and how the immune system is able todiscriminateself vs. non-self
2. Explain how the innate and adaptive immune systems work together to generate aneffectiveimmune responseagainst aspecificpathogen.
3. Explainhowthe immunesystem isable torespond toso manydiverseantigens.
4. To understand the importance of pathogenic microorganisms in human disease withrespecttoinfectionsoftherespiratorytract,gastrointestinaltract, urinarytractetc
5. To understand and able to correlate disease symptoms with causative agent, isolate and identify pathogens.

Unit-1:**Immune System** **No. ofHours:9**

1. Basic concept of (Innate and Adaptive) immunity.
2. Primary and secondary organs of immune system-thymus, bursafabricius, bonemarrow, spleen, lymph nodes and lymphoid tissues
3. Cells of immune system- Identification and function of B and T lymphocytes, nullcells, monocytes, macrophages, neutrophils, basophils and eosinophils
4. Components of innate immunity; Complement system (in brief)

Unit-2: **Immune response** No.ofHours9

1. Characteristics of antigen (Foreign ness, Molecular size, Heterogeneity and (solubility) haptens.
2. Antibodies – Structure and types and functions of antibodies.
3. Immune Response - Primary and Secondary. Humoral Immune Response (Plasma and Memory cells), MHC, Cell Mediated Immune response
4. Ag – Ab reactions (Agglutination, Precipitation, Neutralisation, Complement fixation, Phagocytosis).
5. Hypersensitivity- definition and types (inbrief)

Unit-3: Microbes in Health and Disease **No. ofHours:9**

1. Normal flora of human body.
2. Concepts : Infection, Invasion, Pathogen, Pathogenicity, Virulence,Toxigenicity,Opportunistic infections,

3. Nosocomial infections General account on microbial diseases - causal organism, pathogenesis, epidemiology, diagnosis, prevention and control of the following

A) Bacterial diseases - Tuberculosis, Typhoid, Botulism

B) Fungal diseases - Candidiasis.

C) Viral Diseases- Hepatitis-A and AIDS

Unit - 4: Principles of Diagnostic Microbiology **No. ofHours:9**

1. General principles of diagnostic microbiology- Collection, transport of clinical samples.
2. Isolation and Identification by morphological
3. Identification by biochemical/ physiological properties
4. Identification by molecular assays (PCR, DNA probes)
5. Identification by serological tests (ELISA, Immuno fluorescence, RIA,RIE)

Unit-5:PreventionandTreatment **No. ofHours:9**

1. Vaccines- Active (Natural and recombinant)and passive immunization.
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 (Discdiffusion)

II SkillOutcomes:

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

1**.**Perform some of the ag-ab reactions

2. Carry out the biochemical tests use ful for identification of bacteria

3. Perform antibiotic sensitivity test

4. Identify some common symptoms and relate them to etiology

5. Prepare some differential media routinely used for identification of bacteria

V SEMESTER

COURSE 12A:IMMUNOLOGY AND MEDICAL MICROBIOLOGY

credits-1

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1. Identification of human blood groups.
2. Separate serumfrom 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 bacteria culture medium: EMB Agar, McConkey agar, Mannitol salt agar, Deoxycholate citrate agar,TCBS Isolation of bacterial flora of skin by swab method.
6. Antibacterial sensitivity by Kirby-Bauer method
7. Determination of minimal inhibitory concentration of an antibiotic
8. Study symptoms of the diseases with the help of photo graphs: Anthrax, Polio, Herpes, chicken pox, HPV warts, Dermato mycoses (ringworms)
9. Isolation of Normal flora of human body (Hands, Feet, Nostrils, Teeth Surface) byswabmethod.

III References

1. Ananthanarayan R. and Paniker C.K.J. (2009) Text book 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-Black well Scientific Publication, Oxford.
4. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freemanand Company,New York.
5. Kuby's Immunology.6th edition W.H.Freeman and Company,NewYork.
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'sMicrobiology. 9th edition. McGraw Hill Higher Education Practical microbiology-M.N.ReddyPractical microbiology-M.N.Reddy
8. Microbiology: a laboratorymanual/James G.Cappuccino,Natalie.

9. Plant pathology and Microbiology- K.R.Aneja
10. Mackie & Mccartney Practical Medical Microbiology,

III. Co-CurricularActivities:

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 12B: PHARMACEUTICAL MICROBIOLOGY

credits-3

Course Outcomes:

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

1. Explain the principles of bio safety cabinets and biological waste management
2. Explain the methods of detection of microorganisms in phamaceuticals.
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

Unit1:Introduction toPharmaceuticalMicrobiology No. ofHours:9

1. Identification and characteristics of microorganisms commonly found in pharmaceutical environments.
2. Significance of microbiology in the pharmaceutical industry; Microbial contamination and spoilage of pharmaceutical products.
3. Over view of current Good Manufacturing Practices (cGMP) and regulatory requirements.

Unit2: Microbial Control in Pharmaceuticals No. ofHours: 9

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

Unit3:Microorganisms of Pharmaceutical Importance No. ofHours: 9

1. Principles of a septic techniques and BSL
1. Pathogenic microorganisms and their significance in pharmaceutical products.
2. Environmental monitoring and microbial enumeration techniques; Bioburden test and its importance

Unit4: 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,endotoxinlevels.
4. Environmental monitoring and trend analysis in pharmaceutical facilities.

Unit5:Microbiology in Product Development **No. ofHours: 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. Microbial quality control in vaccine production.

Skill Outcomes:

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

1. Perform sterility tests for equipment.
2. Employ disinfection methods of selected in struments
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

COURSE12B: PHARMACEUTICAL MICROBIOLOGY

credits-1

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1. Sterility tests for Instruments–Autoclave & Hot Air Oven
2. Disinfection of selected instruments & Equipments
3. Sterility test of Air in 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. HarriganWF(1998)LaboratoryMethodsinFoodMicrobiology,3rded.AcademicPress
2. Garg N,GargKLandMukerjiKG(2010) LaboratoryManualof FoodMicrobiologyIKInternational Publishing HousePvt. Ltd.
3. JayJM,LoessnerMJ,GoldenDA(2005)ModernFoodMicrobiology,7thedition.Springer
4. BairdRM, HodgesN A and Denyer S P (2005) Hand book of Microbiological Quality control in Pharmaceutical and Medical Devices,Taylor and FrancisInc.
5. Microbiology-Alaboratorymanual,Cappuccino & Sherman,6th Ed, Pearson Education
6. Manual of diagnostic microbiology,Dr.B.J.Wadher&Dr.G.L.Bhoosreddy,First Ed.,Himalayapublishinghouse, Nagpur.
7. PharmaceuticalMicrobiology–W.B.Hugo
7. Laboratory Exercises in Microbiology, George.A.Wistreich & Max.D.Lechtman,3rd Ed, Glencoepress, London.

IV. Co-CurricularActivities:

1. Visit to pharmaceutical Company
2. Projecton QC and QA methods in pharma
3. Assignments on collecting SoPs from Pharma labs

V SEMESTER

COURSE13A: 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:Entrepreneurialskill **No ofHours: 9**

1. 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 ProductsNoofHours:9

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

Unit–III:Bio-fertilisers andMushrooms **NoofHours:9**

1. Mushroom cultivation–Cultivation of *Agaricus campestris,Calocybaindica, Agaricus bisporus, and Volvariella volvaciae*; Preparation of compost, filling traybeds, spawning, maintain optimal temperature, casing, watering, harvesting, storage.
2. Biofertilizers –Chemical fertilizers versus biofertilizers, organic farming.

Productionofbiofertilisers-Rhizobium sp, Azospirillumsp, Azotobactersp.

3. Microbial consortia used for composting and as biofertilisers

Unit–IV:Baking and Brewing processes NoofHours:9

1. Brewing–Media components, preparation of medium,
2. Microorganisms involved, maturation, carbonation, packaging, contamination by products.
3. Bread making and quality analysis.

Unit–V:DPR and Patents No ofHours: 9

1. Guidelines for the preparation of DPR (Detailed Project Report)
2. Patents and secret processes –History of patenting, composition, subject matter andcharacteristicsofapatent,
3. Inventor,Infringement,cost of patent

Skill Outcomes:

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

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

V SEMESTER

COURSE13A: APPLIED MICROBIOLOGY

credits-1

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1. Preparation of Microbial consortia for composting
2. Field visit and report preparation of Mushroom cultivation unit/ Biofertiliserproductioncentre/or anyother
3. Preparation of sample DPR

References:

1. Entre preneurial Development in India-ByArora.
2. Sathyanarayana.U,Biotechnology.(2005)1st Ed.Books and Allied (P)Ltd.
3. Casida,LEJR,(2019). Industrial Microbiology.NewAge InternationalPublishers
4. K.R.Aneja,ExperimentsinMicrobiology,Plantpathology,Tissuecultureand Mushroomproductiontechnology,6thEd.SChandPublication
5. NdukaOkafor.ModernIndustrialMicrobiologyandBiotechnology.2007.CRCPre s s
6. MichaelJ.Waites,NeilL.Morgan,JohnS.Rockey,GaryHigton.IndustrialMicrobio logy: AnIntroduction.2013.WileyBlackwellPublishers.
7. A.H.Patel.IndustrialMicrobiology.2016.2ndEd.LaxmiPublications,NewDelhi.
8. DubeyRC.ATextbookofBiotechnology.(2014).SChandPublishers.
9. Robert D.Hisrich, Michael P.Peters, “Entrepreneur ship Development”, Tata Mc Gr awHill

II. Co-CurricularActivities:

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

V SEMESTER

COURSE 13B: DIAGNOSTIC MICROBIOLOGY

credits-3

Course Outcomes:

By the completion of the course the learner should 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. Safe guard one self and community from anti bioticmisuse.
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.ofhours:9

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

UNIT-II:Microscopic and culturemethods ofDiagnosis No. of hours:9

1. Examinationofsamplebystaining-Gramstain,Ziehl-Neelson stain for (tuberculosis),Giemsa-stain lishman stain (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 and molecular methods for diagnosis

No.ofhours: 9

1. Agglutination, ELISA, immunofluorescence
2. Types of PCR (Real-Time and Digital PCR (Nucleic Acid Quantification); Multiplex PCR for Detection and Identification of Microbial Pathogens
3. Non amplified Probe-Based methods for Detection and Identification of microorganisms.

UNIT-IV:Antimicrobials- sensitivity and resistance No. ofhours:9

1. Importance of drug resistance
2. Determination of resistance/ sensitivity of bacteria using 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. Molecular tests for detection TB and anti-TB drug resistance.

SkillOutcomes:

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

COURSE13B: DIAGNOSTIC MICROBIOLOGY

credits-1

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1. Collection transport and processing of clinical specimens (Blood, Urine, Stool andSputum).
2. Receipts, Labeling, recording and dispatching clinical specimens. 3 . Isolation ofbacteriain pureculture and Antibioticsensitivity.
3. Identification of common bacteria by studying their morphology, cultural characters,Biochemicalreactions, slide agglutination andother tests.
4. Maintenanceandpreservationofstockculture.

References

1. Ananthanarayan R and Paniker CKJ (2009)Textbook of Microbiology, 8th edition,UniversitiesPress PrivateLtd.
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 HillPublication.
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Co-CurricularActivities:

1. Hands-on training in techniques such as sample collection, microbial culture,staining, identification methods (e.g., biochemical tests), and antimicrobialsusceptibilitytesting.
2. Case Study Analysis individually or in groups to evaluate patient histories,laboratorytest results, anddiagnosticdata to reachadiagnosis.
3. Projectworkoncomparingreportsfromdifferentdiagnosticlabs

V SEMESTER

COURSE 14A: INDUSTRIAL MICROBIOLOGY

credits-3

CourseOutcomes:

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 meta bolites
5. Explain the components of upstream and downs tream bioprocessing

UNITI:Microorganismsofindustrialimportance No. ofhours:9

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

UNITII:ScreeningandStrain Improvement No. ofhours:9

1. Primary and secondary screening.Preservation and maintenance of industrial strains
2. Outlines of strain improvement.
3. Types of fermentation media (Crude and synthetic media; molasses, corn- steep liquor,sulphitewaste liquor,whey, yeast extractand proteinhydrolysates)

UNITIII:Bioreactors No.ofhours: 9

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

UNITIV:FermentationandDownstreamprocesses No.ofhours: 9

1. Measurement and control of fermentation parameters-pH, temperature, dissolved oxygen, foaming and aeration
2. Downstream processing - filtration, centrifugation, cell disruption, solventextraction.

3. Methods of immobilization, advantages and applications of immobilization, large scale applications of immobilized enzymes.

UNITV:MicrobialProductions **No. ofhours: 9**

1. Production of citric acid, ethanol and penicillin.
2. Production of Glutamicacid 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 isolatingmicroorganismsfrom natural environments.
2. Microscopically demonstrate the microorganisms found in fermented food; preparesome of the fermented products(wine) in the laboratory to observe the associatedphysicaland chemical changes.
3. Carryoutmicrobialproductionsinsmallscale(citricacid) andestimatethe product

V SEMESTER

COURSE14A: INDUSTRIAL MICROBIOLOGY

credits-1

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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 citricacid

References:

1. Stanbury,P.F.,Whitaker,A.andHall,S.J.(1997). Principles ofFermentationTechnology, AdityaBooks (P) Ltd.NewDelhi.
2. Doyle,M.P.,Beuchat,L.R.andMontville,T.J.(1997). Food Microbiology: Fundamentals and Frontiers.ASM Press,Washington D.C.,USA.

Co-CurricularActivities:

1. Lectures/Seminar on current trends in industrial microbiology
2. Field visit to related industry
3. Assignments on identifying and procuring industrially important microorganisms

VSEMESTER

COURSE14B: AGRICULTURAL MICROBIOLOGY

credits-3

COURSE OUTCOMES:

By the completion of the course the learner should able to

1. Soil Microbiology: Study soil as a microbial habitat, diversity of microorganisms, and their in teractions.
2. Host Pathogen Interaction: Understand microbial pathogenicity,virulence factors, and plant defense mechanisms.
3. Control of Plant Diseases: Learn principles and practices for managing plantdiseases,includingregulatory,cultural,chemical,andbiologicalmethods.
4. SpecificPlantDiseases:Studyimportantplantdiseasescausedbyfungi,bacteria,viruses,andviroids,focusingontheiretiology,symptoms,epidemiology,and control.
5. Biofertilization,Phytostimulation,Bioinsecticides:Exploreplantgrowth-promoting bacteria, biofertilizers, mycorrhizae, and their role in enhancingplant growth. Learn about bioinsecticides and their advantages over syntheticpesticides.

Unit1:SoilMicrobiology **No ofHours:9**

1. Soil as Microbial Habitat, Soil profile and properties, Soil formation, Diversityanddistribution of microorganisms insoil.
2. Mineralizationofcellulose,hemicelluloses,lignocelluloses,ligninandhumus.
3. Microbial interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation. Microbe-Plant interaction: Symbiotic andnonsymbioticinteractions.

Unit2:Host Pathogen Interaction **No. ofHours:9**

1. Microbial Pathogenicity and Virulence factors of pathogens: enzymes, toxins (hostspecificandnonspecific)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,plantgrowthandreproduction).

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,oxidativebursts].

Unit3:Control ofPlantDiseases No.ofHours: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, croprotation, sanitation, poly ethylene traps and mulches
2. chemical-protectants and systemic fungicides, antibiotics, resistance of pathogens to chemicals. biological-suppressive soils, antagonistic microbes-bacteria and fungi, trapplants
3. Genetic engineering disease resistant plants- (plant derived genes andpathogenderived genes) and Genetically Modifiedcrops.

Unit:4: Study of Plant diseases No. ofHours:9

1. Study of some important plant diseases giving emphasis on its etiological agent, symptoms, epidemiology andcontrol

A. Important diseases caused by fungi

B. Black stem rust of wheat-*Puccinia graministritici*

c. Wilt of tomato-*Fusarium oxysporum f.sp.lycopersici*

D. Early blight of potato- *Alternariasolani*

2. Important diseases caused by phyto pathogenic bacteria: (Angular leaf spot of cotton, bacterial leaf blight of rice, crown galls, cankers of citrus).

3. Important diseases caused by viruses: Papaya ring spot, tomato yellow leaf curl. (Important diseases caused by viroids: Potato spindle tuber, coconut cadang cadang)

Unit5:Biofertilizers,Phytostimulats and Bioinsecticides NoofHours:9

1. Plant growth promoting bacteria, biofertilizers – symbiotic (Bradyrhizobium,Rhizobium, Frankia), Non Symbiotic (Azospirillum, Azotobacter, Phosphatesolubilizers,algae)
2. Importance of mycorrizal inoculum, types of mycorrhizae and associated plants, Mass inoculums production of VAM, field applications of Ectomycorrhizae and VAM.
3. General account of microbes used as bioinsecticides and their advantages oversynthetic pesticides, Bacillus thuringiensis- production and Field

applications,Viruses– cultivation and field applications.

Skill Outcomes:

1. Understand soil composition and characteristics, measuring water activity and pHlevels, interpreting soil profiles, and recognizing the influence of these factors onsoil 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 growthandsoil fertility.
4. Demonstrate field application techniques, and recognize the role of Azotobacter inpromotingplant growth and soil nitrogen availability.
5. Identify cellulose- degrading microorganisms
6. Identify the plant diseases based on section cuttings

Practical papers: Agricultural microbiology

1) Detection of soil micro flora and soil profile.

2) Demonstration of plant diseases and symptoms.

Fungal disease (examples)

Bacterial diseases (examples)

Viral diseases (examples)

3. Detection of fungicides.

4.Detection of VAM fungi.

VSEMESTER

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, andsourcesof microbial contamination.
2. Gain knowledge of Microflora of milk, microbial contamination of raw milk andbutter,and spoilageof various food types.
3. Use dairy starter cultures in fermented dairy products, other fermented foods, andprobiotics.
4. Differentiate Food borne diseases ,intoxications, and infections
5. To adopt food sanitation, control measures, Follow HACCP; Carry out tests to detectpathogens infoods

Unit1:Microbes in Foodand Dairy **No. ofHours: 9**

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

Unit2:Food Preservation **No. ofHours: 9**

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

Unit3:Fermentedfoods **No. ofHours: 9**

1. Dairy starter cultures, fermented dairy products: yogurt, acidophilus milk, kumiss,kefir,dahi andcheese
2. Other fermented foods: dosa, sauerkraut, soy sauce and tempeh, Probiotics: Healthbenefits,types ofmicroorganisms used, probioticfoods availableinmarket.
3. Utilization and disposal of dairy -products–whey.

Unit4:Foodbornediseases **No. ofHours: 9**

1. Food borne diseases (causative agents, foods involved, symptoms and preventivemeasures)
2. Food intoxications: Staphylo coccusaureus, Clostridium botulinum and mycotoxins;
3. Food infections: Bacillus cereus, *Vibrio parahaemolyticus, Escherichia coli,Salmonellosis,*
4. Shigellosis, *Yersinia enterocolitica, Listeria monocytogenes and Campylobacterjejuni*

Unit5:Food Sanitation **No. ofHours: 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 inensuring milk safety.
2. Check the efficiency of pasteurization of milk include understanding the principle ofthe test, performing the enzymatic reaction, interpreting results, and assessing theeffectivenessof milk pasteurization inensuring food safety.
3. Mastering aseptic techniques, perform sample preparation and isolation techniques, identify potential pathogens and spoilage microorganisms, and understand the role ofmicroorganismsin food safety and spoilage.
4. Follow yogurt fermentation protocols, controlling fermentation conditions, assessingyogurtquality,and understandingtheroleofmicrobial culturesinyogurt production.

V SEMESTER

COURSE15 A: FOOD AND DAIRY MICROBIOLOGY

credits-1

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1. MBRTof milk samples
2. Standard plate count method.
3. Alkaline phosphatase test to check the efficiency of pasteurization of milk.
4. Isolation of any foodborne bacteria from food products. Isolation of spoilagemicroorganismsfrom spoiled vegetables/fruits.
5. Isolation of microorganisms from spoiled bread.
6. Preparation of Yogurt/Dahi.

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1. Stanbury,PF.,PrinciplesofFermentationTechnology.Whittaker,Aand Hall,
2. S.J2 nd Edition. PergamonPress(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 (Adivisionof Hodder and Stoughton) London.
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6. JohnGarbult.EssentialsofFoodMicrobiology.ArnoldInternational.
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8. W.H.FreemanandCo.
9. D. J. Bagyaraj and G. Rangaswami. AGRICULTURAL MICROBIOLOGY.PrenticeHall ofIndiaPvt Ltd.2005
10. NSSubbaRao.SoilMicrobiology.OxfordandIBHpublishingCompany2009
11. PhotisPapademas.DairyMicrobiology:APracticalApproach.CRCPress
12. RaoM.K..FoodandDairyMicrobiology. ManglamPublishers
13. WilliamFrazier.FoodMicrobiology.McGrawHillEducation
14. Jay,JamesM., Loessner,Martin J.,Golden,David ModernFoodMicrobiology.Springer.

Co-CurricularActivities:

1. Food Microbiology Work shops
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

COURSE14B: AGRICULTURAL MICROBIOLOGY

credits-1

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1. Study soil profile,water activity, pH
2. Study microflora of different types of soils
3. Rhizobium as soil inoculant, characteristics and field application.
4. Azotobacter as soil inoculant, characteristics and field application
5. Isolation of cellulose degrading organisms
6. Demonstration of Koch's postulates in fungal, bacterial and viral plant pathogens.
7. Study of important diseases of crop plants by cutting sections of infected plantmaterial(microscopicobservations)Albugo,Puccinia,Ustilago,Fusarium,Colletotrichum.
8. Detection of VAM fungi.

References:

1. AgriosGN.(2006).PlantPathology.5thedition.Academicpress, SanDiego,
2. .LucasJA.(1998).Plant Pathology and PlantPathogens.3rd edition.BlackwellScience,Oxford.
3. MehrotraRS.(1994).PlantPathology.TataMcGraw-HillLimited.
4. RangaswamiG.(2005).Diseases of Crop Plants India.4th edition.Prentice Hall IndiaPvt.Ltd.,NewDelhi.
5. SinghRS.(1998).PlantDiseasesManagement.7thedition.Oxford&IBH,NewDelhi.

Co-Curricular Activities:

1. Project on collecting photographs of diseased plants and identification

2. Project on collecting photographs of diseased plant parts and identificationofpathogen

3. Work shops/Lectures on naturalfarming methods

V SEMESTER

COURSE15 B:ENVIRONMENTALMICROBIOLOGY

credits-3

Course Outcomes:

By the completion of the course the learner should able to

1. Explore ecosystems (terrestrial, aquatic, atmospheric) and microflora in soil, water, atmosphere, human/animal bodies.
2. Learn about mutualism, synergism, commensalism, competition, parasitism,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 micro organisms in bioremediation processes

Unit1:Microorganisms and their Habitats **No. ofHours: 9**

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

Unit2:MicrobialInteractions **No. ofHours: 9**

1. Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation Microbe-Plant interaction: Symbiotic andnonsymbioticinteractions
2. Microbe-animal interaction: Microbes in ruminants, nematophagus fungi andsymbioticluminescent bacteria.
3. Extreme Habitats: Extremophiles: Microbes thriving a thigh & low temperatures, pH, highhy drostatic & osmotic pressures, salinity, & low nutrient levels.

Unit3:BiogeochemicalCycling **No. ofHours:9**

1. Carboncycle:Microbial degradation of cellulose, hemicelluloses, lignin and chitin

2. Nitrogen cycle: Nitrogenfixation, ammonification, nitrification, denitrification and nitrate reduction

3.Phosphoruscycle:Phosphateimmobilizationandsolubilisation. Sulphurcycle:Microbes involved in sulphurcycle.

Unit4: Waste Managemen No. of Hours: 9

1. Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal (composting and sanitarylandfill)
2. Liquid waste management: Composition and strength of sewage (BOD andCOD), Primary, secondary (oxidation ponds, trickling filter, activated sludgeprocessand septictank) and tertiarysewagetreatment
3. Treatment and safety of drinking (potable) water, methods to detect potabilityof water samples: (a) standard qualitative procedure: presumptive test/MPNtest, confirmed and completed tests for faecal coliforms (b) Membrane filtertechniqueand (c) Presence/absencetests

Unit5:Microbial Bioremediation No. of Hours:9

1. Bioremediation: Principles and degradation of common pesticides, organic(hydrocarbons,oilspills) and inorganic (metals) matter, bio-surfactants.
2. Bioleaching, mineral recovery, removal of heavy metals from aqueous effluents.Biode gradable plastics.
3. Biogasproduction: Methane and hydrogen production using microbial culture.

Skill Outcomes:

1. Assess soil properties (pH, moisture content, water holding capacity, percolation, capillaryaction) and understand the irimpact onplant 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 waste water treatment efficiency.

V SEMESTER

COURSE15 B: ENVIRONMENTAL MICROBIOLOGY

Practical 02hr/week credits-1

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1. Analysis of soil - pH, moisture content, water holding capacity, percolation, 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 MPN method.
5. Determination of BOD of wastewater sample.
6. Determination of COD of waste water sample
7. Study the presence of microbial activity by detecting (qualitatively) enzymes (dehydrogenase,amylase, urease) in soil.
8. Isolation of Rhizobiumfrom root nodules.
9. Isolation of Azotobacter from soil.
10. Designand functioning of abiogasplant.

III. References

1. AtlasR Mand Bartha R. (2000). Microbial Ecology: Fundamentals & Applications.4th edition. Benjamin/Cummings Science Publishing, USA
2. Madigan MT, Martinko JM and ParkerJ.(2014). Brock Biology of Microorganisms. 14th edition. Pearson/ Benjamin Cummings
3. MaierRM,PepperILandGerbaCP.(2009).EnvironmentalMicrobiology.2ndedition, AcademicPress
4. Okafor,N(2011).EnvironmentalMicrobiologyofAquatic&Wastesystems.1stedition, Springer, New York
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8. Lynch JM & Hobbie JE. (1988). Microorganisms in Action: Concepts &ApplicationinMicrobialEcology.BlackwellScientificPublication,U.K.
9. Martin A. (1977). An Introduction to Soil Microbiology. 2nd edition. JohnWiley& Sons

Inc.NewYork & London.

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11. SubbaRaoNS.(1999).SoilMicrobiology.4thedition.Oxford&IBHPublishingCo.New Delhi.
12. WilleyJM,SherwoodLM,andWoolvertonCJ.(2013).Prescott'sMicrobiology.9th edition. McGrawHillHigherEducation.

IV. Co-CurricularActivities:

1. Project work on assessment of different soil types
2. Preparea Model of Bio gas plant
3. Prepare amodel of sewage treatment plant

YOGI VEMANA UNIVERSITY: KADAPA

Department of Microbiology

Model Question Paper for ALL Semesters (Semester End Examination) W.E.F 2023-24

Course 1:

Time: 3 Hrs Maximum Marks: 75

Section-A

Answer any five of the following questions.
Two questions should be given from each unit

5x5=25 marks

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

Section-B

Answer all of the following questions.
Two Questions (A & B) from each unit in the syllabus. **5x10=50 marks**

11. a)

or

b)

12. a)

or

b)

13. a)

or

b)

14. a)

or

b)

15. a)

or

b