Government College for Women(A), Guntur.

COURSE INFORMATION BOOKLET

DEPARTMENT OF MICROBIOLOGY

Vision and Mission of the Department

VISION

To produce graduates with relevant education descriptors and hands-on skills in microbiology and to enable them to become imaginative, integrated beings who constructively and creatively contribute to environment and society and play a vital role in the advancement of learning and understanding.

MISSION

- Imparting relevant knowledge and creating an atmosphere to develop innovative and critical thinking.
- Skill enhancement through hands-on training and value-added courses plus add on courses.
- Sustained focus on high-quality teaching, internships in industries encouraging scientific thinking and approach.
- Creating an environment for holistic development of individuals with emphasis on spirit of integrity, equity, professional ethics and social harmony through the exposure and participation in co-curricular, extracurricular and extension activities.

PROGRAMME SPECIFIC OUTCOMES (PSO)

After successful completion of the programme a student will acquire following competencies:

PSO1: Understand the physiological and environmental adaptations, molecular aspects, the applicability and significance of microorganisms in the field of health, food, industry,agriculture and environment.

PSO2: Carry our standard laboratory techniques in the field of molecular biology, immunology, environmental, medical, food, agriculture and industrial microbiology.

PSO3: The programme will provide students with the knowledge and skill base that wouldenable them to undertake further studies and research in microbiology and related areas or in multidisciplinary areas that involve microbiology.

PSO4: Graduates will develop critical thinking and able to analyse and interpret scientific data. They shall be equipped with practical skills and competencies to become employed indiagnostic, industrial, pharmaceutical, food, environmental and research laboratories.

PSO5: The ability to become an entrepreneur by using microorganisms to produce biofertilizers, mushrooms, antibiotics and commercially important biomolecules.

List of Programmes offered by the Department

S. No	Title of the programme
1	B.Sc. Honors in Microbiology

Course structure for I - V Semesters of B. Sc. Microbiology Honors – Major Programme (w.e.f.2023-24)

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
COMMUNITY SERVICE PROJECT					
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
		9	Molecular Biology and Microbial Genetics	3	3
			Molecular Biology and Microbial Genetics	2	1
		10	Microbial Physiology and Metabolism	3	3

	IV		Microbial Physiology and Metabolism	2	1
		11	r DNA technology, Biostatistics& Bioinformatics	3	3
			r DNA technology, Biostatistics &Bioinformatics	2	1
SHORT TERM INTERNSHIP					
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
			Food and Dairy Microbiology	**3**	3
			Food and Dairy Microbiology	**2**	1
			OR		
			Environmental Biotechnology	**3**	3
			Environmental Biotechnology	**2**	1
			Internship		

Course structure for I - V Semesters of B. Sc. Microbiology Honors – Minor Programme

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

B.Sc., MICROBIOLOGY (HONOURS) SYLLABUS (W.E.F. 2023-24)
SEMESTER- I

1LS-CM-01: 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.

Course Outcomes:
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.

Unit 1: 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.

Unit 2: Essentials of Botany.
2.1. The classification of plant kingdom. 2.2. Plant physiological processes (Photosynthesis, Respiration, Transpiration, phytohormones). 2.3. Structure of flower – Micro and macro sporogenesis, pollination, fertilization and structure of mono and dicot embryos. 2.4 Mushroom cultivation, floriculture and landscaping.

Unit 3: 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 (Gametogenesis, Fertilization, Cleavage and Organogenesis) 3.4 Economic Zoology – Sericulture, Apiculture, Aquaculture

Unit 4: Cell biology, Genetics and Evolution
4.1. Cell theory, Ultrastructure 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

Unit 5: 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, noncovalent – Vander Waals, hydrophobic, hydrogen bonds. 5.4. Green chemistry

REFERENCES:

1. Sharma O.P., 1993. Plant taxonomy. 2nd Edition. McGraw Hill publishers.
2. Pandey B.P., 2001. The textbook of botany Angiosperms. 4th edition. S. Chand publishers, New Delhi, India.
3. Jordan E.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.
5. Sathyanarayana U., Chakrapani, U., 2013. Biochemistry. 4th Edition. Elsevier publishers.
6. Jain J.L., Sunjay Jain, Nitin Jain, 2000. Fundamentals of Biochemistry. S. Chand publishers, New Delhi, India.
7. Karen Timberlake, William Timberlake, 2019. Basic chemistry. 5th Edition. Pearson publishers.
8. Subrata Sen Gupta, 2014. Organic chemistry. 1st Edition. Oxford publishers.

ACTIVITIES:

1. Make a display chart of life cycle of nonflowering 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 nearby mushroom cultivation unit and know the economics of mushroom cultivation.
10. Draw the Ultrastructure 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 / Sericulture / Apiculture / Aquaculture unit
14. List out different hormonal, genetic and physiological disorders from the society

B.Sc, MICROBIOLOGY (HONOURS) SYLLABUS (W.E.F. 2023-24)
SEMESTER- I

1LS-CM-02: 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 bioinformatics.

Course Outcomes:

1. Learn the history, ultrastructure, diversity and importance of microorganisms
2. Understand the structure and functions of macromolecules, immune system and types of Immunity, biotechnology principles and its applications in food and medicine.
3. Outline the techniques, tools and their uses in diagnosis and therapy.
4. Demonstrate the bioinformatics and statistical tools in comprehending the complex biological data.

Unit 1: Essentials of Microbiology and Immunology No. of hours: 15

1.1. History and Major Milestones of Microbiology; Contributions of Antony von Leewenhock, Edward Jenner, Louis Pasteur, Robert Koch and Joseph Lister.
1.2. Groups of Microorganisms – General characteristics of prokaryotic (Bacteria & Archaea) and Eukaryotic Microorganisms (Fungi) and Viruses.
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.

Unit 2: Essentials of Biochemistry No. of hours: 15

2.1. Biomolecules I – Classification of Carbohydrates and biological importance of Monosaccharides and disaccharides. Classification and biological importance of Lipids.
2.2. Biomolecules II – General properties and classification of Amino acids based on polarity. Classification of proteins based on function. Biologically important peptides.
2.3. Biomolecules III – Structure and functions of Nucleic acids -DNA and RNA: t-RNA, m-RNA, r-RNA.
2.4. Basics of Metabolism – Concept on Anabolism and catabolism

Unit 3: Essentials of Biotechnology No. of hours: 15

3.1. History, scope, and significance of biotechnology. Applications of biotechnology in Plant, Animal, Industrial and Pharmaceutical sciences.
3.2. Environmental Biotechnology – Bioremediation and Biofuels, Biofertilizers and Biopesticides.
3.3. Outlines of 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, abiotic stress – salt tolerance). Transgenic animals – Sheep and disease models.

Unit 4: Analytical Tools and techniques in biology – Applications No. of hours: 15

4.1. Applications in forensics – PCR and DNA fingerprinting
4.2. Immunological techniques – Immunoblotting and ELISA.
4.3. Monoclonal antibodies – Applications in diagnosis and therapy.
4.4. Eugenics and Gene therapy

Unit 5: Biostatistics and Bioinformatics No. of hours: 15

5.1. Introduction to biostatistics, organization of statistical investigation, types of data- primary and secondary data, methods of data collection; sampling- methods of sampling- random, nonrandom; central tendency definition with example – mean, median, mode
5.2. Measures of dispersion – introduction, range, standard deviation and variance – definition and formula; probability- introduction, definition with example;
5.3. Introduction to Bioinformatics; types of biological data; Scope and Applications of Bioinformatics in various fields of biology.
5.4. Genomics- nucleic acid data bases – NCBI, EBI; Proteomics; Protein databases – SWISS-PROT. Accessing Nucleic Acid and Protein databases, NCBI Genome Workbench

Additional module (Not for examination): Tests of significance- student T test, chi square test. Protein Databases: PDB, Protein 3D structures

REFERENCES

1. Gerard J., Tortora, Berdell R. Funke, Christine L. Case., 2016. Microbiology: An Introduction. 11th Edition. Pearson publications, London, England.
2. Micale, J. Pelczar Jr., E.C.S. Chan., Noel R. Kraig., 2002. Pelczar Microbiology. 5 th Edition. McGraw Education, New York, USA.
3. Sathyanarayana U., Chakrapani, U., 2013. Biochemistry. 4th Edition. Elsevier publishers.
4. Jain J.L., Sunjay Jain, Nitin Jain, 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, Upadhyay and Nath. 2016. Biophysical Chemistry, Principles and Techniques. Himalaya Publishing House.
8. Arthur M. Lesk. Introduction to Bioinformatics. 5th Edition. Oxford publishers.
10. AP Kulkarni, 2020. Basics of Biostatistics. 2nd Edition. CBS publishers.

ACTIVITIES

1. Identification of given organism as harmful 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 biostatistics.
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 3D models of genetic engineering techniques.
12. Preparation of 3D models of transgenic plants and animals.

[NOTE: In the colleges where there is 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]

B.Sc, MICROBIOLOGY (HONOURS) SYLLABUS (W.E.F. 2023-24)

II SEMESTER

2MB-03: INTRODUCTION TO MICROBIOLOGY

4hours/Week **Credits -3**

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

1. Understand the historical significance of microbiology and the contributions of key scientists.
2. Recognize the classification of microorganisms and their place in the living world and comprehend the scope and applications of microbiology, including the origin of microbial life and the distinction between eukaryotic and prokaryotic cells.
3. Describe the characteristics of bacteria, archaea, fungi, algae, protozoa, viruses and their diversity.
4. 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:12

1.1 Discovery of Microscope and microbial world by Anton von Leeuwenhoek

1.2 Golden era of Microbiology- Refutation of abiogenesis; Germ theory of Disease; Discovery of vaccination; Discovery of penicillin

1.3 Major contributions of Scientists: Edward Jenner, Louis Pasteur, Robert Koch, Joseph Lister, Ivanowsky, Martinus Beijerinck and Sergei Winogradsky, Alexander Fleming

Unit - 2: Place of Microorganisms in the living world No. of Hours:12

2.1. Haeckel's three Kingdom concept, Whittaker's five kingdom concept, three domains concept of Carl Woese

2.2 Definition and scope of Microbiology; Applications of Microbiology; Diverse groups of Microorganisms

2.3. Origin of microbial life on earth- Timeline, Miller's Experiment, endosymbiosis (cyanobacteria), distinguishing features of eukaryotic and prokaryotic cell

Unit - 3: Prokaryotic microorganisms and Viruses No. of Hours:12

3.1. General characteristics of Bacteria (Morphology, Nutrition- metabolic diversity and reproduction)

3.2. General characteristics of Archaea. Differentiating characters of Archaea and Bacteria.

3.3 General characteristics of virus (Nature, composition, size, host specificity, diversity in structure)

Unit - 4: Eukaryotic microorganisms No. of Hours: 12

4.1. Fungi - Habitat, nutrition, vegetative structure and modes of reproduction;

4.2. Micro Algae- Habitat, thallus organization, photosynthetic pigments, storage forms of food, reproduction.

4.3. Protozoa–Habitat, cell structure, nutrition, locomotion, excretion, reproduction, encystment.

Unit - 5: Growing Microbes in Lab No. of Hours:12

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

5.2. Brief outline of Pure culture, mixed culture and contaminated culture

5.3. Staining techniques of bacteria and fungi. Observation of colour, size and shape of colonies;

III. Skill Outcomes:

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

II SEMESTER

2MB-03P: INTRODUCTION TO MICROBIOLOGY

2hours/Week **Credits -1**

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

References:

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

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.
3. Field Trips to Microbiology-related Sites
4. Establish a Microbiology Journal Club where students can review and discuss scientific articles related to microbiology

B.Sc, MICROBIOLOGY (HONOURS) SYLLABUS (W.E.F. 2023-24)

II SEMESTER

2MB-04: BACTERIOLOGY AND VIROLOGY

4hours/Week **Credits -3**

I. Course Outcomes: On successful completion of the course, the students will be able to

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

Unit -1: Bacterial Taxonomy and Ultrastructure No. of Hours: 12

1.1. Introduction to prokaryotic diversity and taxonomy. Types of classification: Numerical and Phylogenetic classification systems.
1.2. Introduction to Bergy's manual of Systematic Bacteriology
1.3. Non-Culturables and Metagenomics
1.4. Ultrastructure of a Bacterial Cell-Invariable components -cell wall, Structure and/Functions of cell membrane, cytoplasm, nucleoid; Variable components- plasmid, inclusion bodies, flagella (structure and arrangement), pili, capsule, endospore.

Unit - 2: Type studies of Bacteria and Archaea No. of Hours:12

2.1. Salient features of: a) Photosynthetic bacteria - Purple bacteria, Green bacteria and Anabaena b) Gliding bacteria - Myxobacteria and Cytophaga group c) Filamentous - Actinomycetes d) Spore forming bacteria - Bacillus and Clostridia e) Miscellaneous – Mycoplasma, Rickettsia, Chlamydia
2.2. Salient features of Fermentative bacteria, Sulphur bacteria, Nitrogen fixing bacteria
2.3. Salient features of Extremophiles- Methanogens and halobacteria.

Unit- 3: General Properties and Classification of Viruses No. of Hours:12

3.1. Discovery of viruses, Nature and definition of viruses, general properties
3.2. Hierarchy of ICTV nomenclature
3.3. Outline of Baltimore system of classification.
3.4. Cultivation of Viruses, Virus Purification and Assay.

Unit-4: Replication of Viruses No. of Hours:12

4.1. General features of Viral Replication
4.2. Replication of bacteriophages: T4, lambda; Replication of plant viruses: TMV

4.3. Replication of animal viruses: Polio, Influenza, Adeno Virus, HIV

Unit-5: Pathogenic and other Viruses No. of Hours:12

5.1. Defective Viruses- Viroids, virusoids, satellite viruses and Prions.
5.2. Emergence of Viral Pathogens, Introduction to Oncogenic viruses, Concept of Oncogenes and Protooncogenes
5.3. Role of viruses in Ecosystems; Applications in Biotechnology: Vectors, vaccines and gene therapy

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

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

II SEMESTER
2MB-04P: BACTERIOLOGY AND VIROLOGY

2hours/Week **Credits -1**

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

References:

1. Prescott, M.J., Harley, J.P. and Klein, D.A. Microbiology. 5th Edition WCB Mc Graw 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. VI Edition, Jones and Bartlett Publishers. Sudbury. Massachusetts, (2001).
4. Black J.G. Microbiology-Principles and Explorations. John Wiley & Sons Inc. New York, (2002).
5. Tom Besty, D.C Jim Koegh. Microbiology Demystified McGRAW-HILL.
6. Christopher Burrell Colin Howard Frederick Murphy. Fenner and 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 healthcare institutions

REVISED SYLLABUS (W.E.F. 2020-21)
MB404-3: MOLECULAR BIOLOGY AND MICROBIAL GENETICS
SEMESTER- III

TOTAL HOURS: 60 **CREDITS: 4**

Course Outcomes:
On completion of the course, the students will be able to
1. Understand the structure and functions of DNA and RNA in the cell.
2. Gain insight into the most significant molecular biology and rDNA techniques used today.
3. List the factors causing DNA damage and gain understanding about DNA repair mechanisms.
4. Acquire and demonstrate the knowledge about the mechanism of replication, transcription, translation and recombination in bacteria.

UNIT-I No. of hours: 12

Nucleic Acids: DNA structure- Nucleotides, Watson and crick model of DNA, Types of DNA; Organization of DNA in Prokaryotes. RNA- Types of RNA, Structure and functions of t-RNA, m-RNA and r-RNA Experiments that established DNA and RNA as genetic material.

UNIT-II **No. of hours: 12**

Replication of DNA in Prokaryotes: Bidirectional and unidirectional replication, Semiconservative replication, Proof of Semiconservative replication (Messelson – Stahl Experiment). Mechanism of DNA Replication in Prokaryotes: Enzymes and factors involved in replication- Primase, Helicase, Gyrase, DNA polymerases, DNA ligase, SSB proteins. Extra chromosomal genetic elements: General characteristics, types and applications of Plasmids and transposons.

UNIT-III **No. of hours: 12**

Concept of gene: Muton, Recon and Cistron; One gene-one enzyme and one gene - one polypeptide and One gene – One Product hypotheses. Types of genes: structural, constitutive, regulatory genes. Genetic code. Structure of ribosomes.
Protein synthesis in Prokaryotes: Transcription- Definition, difference from replication, promoter, RNA Polymerase, mechanism of transcription. Translation- Charging of t-RNA,

aminoacyl tRNA synthetases, Mechanisms of initiation, elongation and termination of polypeptides. Inhibitors of protein synthesis: Nalidixic acid, Streptomycin, Chloramphenicol. Regulation of gene expression in bacteria – *lac* operon.

UNIT-IV **No. of hours: 12**

Outlines of DNA damage and repair mechanisms: Mutations- Definition and types of Mutations, Spontaneous and induced, base pair changes, frame shifts, deletions, inversions, tandem duplications, insertions. Mutagens - Physical and Chemical mutagens. Uses of mutations. DNA Repair- Direct repair, Excision repair, Mismatch Repair, Recombination Repair, SOS Repair. Genetic recombination in bacteria: Conjugation, Transformation and Transduction.

UNIT-V **No. of hours: 12**

Basic principles of genetic engineering.
Restriction endonucleases, DNA polymerases and ligases. Vectors.
Outlines of gene cloning methods.
Polymerase chain reaction. RT PCR; Genomic and cDNA libraries.
General account on application of genetic engineering in industry, agriculture and medicine.

MB404-3P: MOLECULAR BIOLOGY AND MICROBIAL GENETICS (PRACTICAL)
SEMESTER-III

TOTAL HOURS: 30 **CREDITS: 1**

1. Study of different types of DNA and RNA using micrographs and model / schematic representations
2. Study of semi-conservative replication of DNA through micrographs / schematic representations
3. Isolation of genomic DNA from *E. coli*
4. Resolution and visualization of DNA by Agarose Gel Electrophoresis.
5. Resolution and visualization of proteins by Polyacrylamide Gel Electrophoresis (SDS-PAGE).
6. Problems related to DNA and RNA characteristics, Transcription and Translation.
7. Induction of mutations in bacteria by UV light.
8. Instrumentation in molecular biology – Ultra centrifuge, Transilluminator, PCR

SUGGESTED READINGS

1. Freifelder, D. (1990). Microbial Genetics. Narosa Publishing House, New Delhi.
2. Freifelder, D. (1997). Essentials of Molecular Biology. Narosa Publishing House, New Delhi.
3. Glick, B.P. and Pasternack, J. (1998). Molecular Biotechnology, ASM Press, Washington D.C., USA.
4. Lewin, B. (2000). Genes VIII. Oxford University Press, England

5. Maloy, S.R., Cronan, J.E. and Freifelder, D. (1994). Microbial Genetics, Jones and Bartlett Publishers, London.
6. Ram Reddy, S., Venkateshwarlu, K. and Krishna Reddy, V. (2007) A text Book of Molecular Biotechnology. Himalaya Publishers, Hyderabad.
7. Sinnot E.W., L.C. Dunn and T. Dobzhansky. (1958). Principles of Genetics. 5 th Edition. McGraw Hill, New York.
8. Smith, J.E. (1996). Biotechnology, Cambridge University Press.
9. Snyder, L. and Champness, W. (1997). Molecular Genetics of Bacteria. ASM press,
10. Strickberger, M.W. (1967). Genetics. Oxford & IBH, New Delhi.
11. Verma, P.S. and Agarwal, V.K. (2004). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Co. Ltd., New Delhi.

B.Sc, MICROBIOLOGY (CBCS) REVISED SYLLABUS (W.E.F. 2020-21)

MB404-4: MEDICAL MICROBIOLOGY AND IMMUNOLOGY

SEMESTER- IV

TOTAL HOURS: 60 **CREDITS: 4**

Learning Outcomes:

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

1. Understand and recall the underlying principles of immunology, mechanism of action of antimicrobial drugs and principle of antimicrobial susceptibility tests.
2. Discuss about general methods of laboratory diagnosis and principles of vaccination.
3. Acquire the knowledge about the normal microflora and common pathogenic organisms associated with human infections
4. Apply the knowledge of serological reactions in diagnosis of diseases.

UNIT-I **No. of hours: 12**

Types of immunity – innate and acquired; active and passive; humoral and cell-mediated immunity. Primary and secondary immune response. Primary and secondary organs of immune system – thymus, bursa of fabricius, bone marrow, spleen and lymph nodes.

Cells of immune system- Identification and function of B and T lymphocytes, null cells, monocytes, macrophages, neutrophils, basophils and eosinophil.

UNIT-II **No. of hours: 12**

Antigens – types, chemical nature, antigenic determinants, haptens, Factors affecting antigenicity.

Antibodies – basic structure, types, properties and functions of immunoglobulin.

Types of antigen-antibody reactions - Precipitation Agglutination, Neutralization, complement fixation.

Labelled antibody-based techniques – ELISA, RIA and Immunofluorescence.

Polyclonal and monoclonal antibodies – production and applications.

Concept of hypersensitivity and Autoimmunity.

Additional module: MHC, complement (not to be included in exam).

UNIT-III **No. of hours: 12**

Normal flora of human body.
Host pathogen interactions: infection, invasion, pathogen, pathogenicity, virulence, Toxicity. Opportunistic infections.
General account on nosocomial infections- Bacterial infections.
General principles of diagnostic microbiology- collection, transport and processing of clinical samples.
General methods of laboratory diagnosis - cultural, biochemical, serological and molecular methods.

UNIT-IV **No. of hours: 12**

Antibacterial Agents- Penicillin, Streptomycin
Antifungal agents – Amphotericin B, Griseofulvin
Antiviral substances - Amantadine and Acyclovir
Tests for antimicrobial susceptibility.
Brief account on antibiotic resistance in bacteria
Vaccines –Natural and recombinant vaccines.

UNIT-V **No. of hours: 12**

General account on microbial diseases – causal organism, pathogenesis, epidemiology, diagnosis, prevention and control
Bacterial diseases – Tuberculosis and Typhoid
Fungal diseases – Aspergillosis
Protozoa diseases – Malaria.
Viral Diseases - Hepatitis- A and AIDS

MB404-4P: IMMUNOLOGY AND MEDICAL MICROBIOLOGY (PRACTICAL)

TOTAL HOURS: 30
CREDITS: 2

1. Identification of human blood groups.
2. Separate serum from the blood sample (demonstration).
3. Estimation of blood haemoglobin.
4. Total Leukocyte Count of the given blood sample.
5. Differential Leukocyte Count of the given blood sample.
6. Immunodiffusion by Ouchterlony method.
7. Identify bacteria (*E. coli*, *Pseudomonas*, *Staphylococcus*, *Bacillus*) using laboratory strains on the basis of cultural, morphological and biochemical characteristics: IMViC, urease production and catalase tests
8. Isolation of bacterial flora of skin by swab method.
9. Antibacterial sensitivity by Kirby-Bauer method
10. Study symptoms of the diseases with the help of photographs: Anthrax, Polio, Herpes, chicken pox, HPV warts, Dermatomycoses (ring worms)
11. Study of various stages of malarial parasite in RBCs using permanent mounts.

SUGGESTED READINGS

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

B.Sc, MICROBIOLOGY (CBCS) REVISED SYLLABUS (W.E.F. 2020-21)
MB404-5: FOOD AGRICULTURE AND ENVIRONMENTAL MICROBIOLOGY
SEMESTER- IV

TOTAL HOURS: 60 **Credits- 4**

Course outcomes

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

1. Learn and understand the role of microbes in biogeochemical cycling
2. Acquire in-depth knowledge about of spoilage of food products and principles of preservation, understand about fermented foods and probiotics.
3. Apply the knowledge about microbes in solid waste and sewage management, microbial assessment of water quality.
4. Analyze and test the methods of crop improvement by using biofertilizers and biopesticides.

UNIT- I **No. of hours: 12**

Intrinsic and extrinsic parameters that affect microbial growth in food
Microbial spoilage of food – fruits and vegetables, milk, meat, bread and canned foods
Food intoxication (botulism).
Food-borne diseases (salmonellosis) and their detection.

UNIT – II **No. of hours: 12**

Principles of food preservation- Physical and chemical methods
Fermented Dairy foods- Cheese and yogurt
Microorganisms as food –SCP, edible mushrooms (White button, oyster and paddy straw), prebiotics, Probiotics and their benefits.

Additional module: Food ethics, safety, regulations associated with probiotics, prebiotics

UNIT - III **No. of hours: 12**

Terrestrial Environment: Soil profile and soil micro flora
Aquatic Environment: Microflora of fresh water and marine habitats
Atmosphere: Aeromicroflora and dispersal of microbes
Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels.
Microbial interactions – Mutualism, Commensalism, Antagonism, Competition, Parasitism, Predation.

UNIT – IV **No. of hours: 12**

Meaning and examples of Rhizosphere and Phyllosphere Flora. Role of microorganisms in nutrient cycling (Carbon, nitrogen), biological nitrogen fixation (symbiotic, non-symbiotic).
Importance of Mycorrhizae – Types, Mass inoculums and Importance of Mycorrhiza
Biofertilizers - *Cyanobacteria*
Microbial Insecticides (Any two)
Symptoms of Plant diseases - groundnut rust, Citrus canker
Biodegradation of pesticides.

UNIT – V **No. of hours: 12**

Methods to detect portability of water samples: (a) Standard qualitative procedure: Presumptive test/MPN test, Confirmed and completed tests for faecal coliforms (b) Membrane filter technique.
Outlines of Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal (composting and sanitary landfill).
Liquid waste management: Composition and strength of sewage (BOD and COD), Primary, secondary (oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment.

Additional module: Principles of plant disease control, Bioplastics (not to be included in exam).

MBP 404-5P: FOOD, AGRICULTURE AND ENVIRONMENTAL MICROBIOLOGY (PRACTICAL)

Total hours: 30 **Credits:2**

1. Isolation of bacteria and fungi spoiled bread / fruits / vegetables
2. Preparation of yogurt / dahi
3. Determination of microbiological quality of milk sample by MBRT
4. Enumeration of bacteria, fungi and actinomycetes from soil
5. Enumeration and identification of rhizosphere microflora
6. Isolation of rhizobium from root nodules.
7. Isolation of Azatobacter from soil.
8. Observation description of any three bacterial and fungal plant diseases
9. Staining and observation of VAM.
10. Analysis of soil - pH, Moisture content and water holding capacity.
11. Study of air flora by petriplate exposure method.
12. Analysis of potable water: SPC, Presumptive, confirmed and completed test, determination of coli form count in water by MPN.
13. Determination of Biological Oxygen Demand (BOD) of waste water samples.

SUGGESTED READINGS:

1. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition, Benjamin/Cummings Science Publishing, USA.
2. Barton LL & Northup DE (2011). Microbial Ecology. 1st edition, Wiley Blackwell, USA
3. Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
4. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.
5. Lynch JM & Hobbie JE. (1988). Microorganisms in Action: Concepts & Application in Microbial Ecology. Blackwell Scientific Publication, U.K.
6. Madigan MT, Martinko JM and Parker J. (2014). Brock Biology of Microorganisms. 14th edition. Pearson/ Benjamin Cummings.
7. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press.
8. Martin A. (1977). An Introduction to Soil Microbiology. 2nd edition. John Wiley & Sons Inc.New York & London.
9. Okafor, N (2011). Environmental Microbiology of Aquatic & Waste systems. 1st edition, Springer, New York.
10. Singh A, Kuhad, RC & Ward OP (2009). Advances in Applied Bioremediation. Volume 17, Springer-Verlag, Berlin Hedeilberg
11. Stolp H. (1988). Microbial Ecology: Organisms Habitats Activities. Cambridge University Press,Cambridge, England.
12. Subba Rao NS. (1999). Soil Microbiology. 4th edition. Oxford & IBH Publishing Co. New Delhi.
13. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescottís Microbiology. 9th edition. McGraw Hill Higher Education

B.Sc, MICROBIOLOGY (CBCS) REVISED SYLLABUS (W.E.F. 2020-21)
MB404-6A INDUSTRIAL MICROBIOLOGY
SEMESTER- V

TOTAL HOURS: 60 **CREDITS: 4**

Course Outcomes:
On completion of the course, the students will be able to

1. Describe the industrially important microorganisms.
2. Differentiate primary and secondary microbial products.
3. Explain the techniques of screening industrially important metabolites from microbes
4. They can discuss about different types of fermentations.
5. Demonstrate the knowledge and understanding of Microbial production of industrial products.

UNIT I **No. of hours 12**

Microorganisms of industrial importance - yeasts (*Saccharomyces cerevisiae*), moulds (*Aspergillus niger*) bacteria (E.coli), Actinomycetes (*Streptomyces griseus*). Industrially important Primary and secondary microbial metabolites. Screening techniques. Techniques involved in selection of industrially important metabolites from microbes. Strain improvement Techniques. Concept on Intellectual property rights.

UNIT II **No. of hours 12**

Concept and history of fermentation; Basic concepts of Design of fermenter– Fermenter and its parts; Types of fermenters- batch, continuous and fed batch. Types of fermentation processes: solid state, liquid state, batch, fed-batch, continuous. Ingredients of Fermentation media. Downstream processing - filtration, centrifugation, cell disruption, solvent extraction.

UNIT III **No. of hours 12**

Microorganisms involved in Pharma and therapeutic enzymes. Enzymes used in detergents, textiles and leather industries. Production of amylases and Proteases. Production of therapeutic enzymes-Streptokinase. Role of microorganisms in bioleaching, and textile industry. Biodeterioration of Paper, Paint, Textiles.

UNIT IV **No. of hours 12**

Industrial microorganisms: cell growth, microbial growth kinetics, factors affecting growth, Principles of production media, components of media, chemical composition of media. Microbial production of Industrial products: Citric acid Ethanol, Penicillin and vitamin B12

UNIT V **No. of hours 12**

Bioreactors: basic structure of bioreactor, types of bioreactors. Kinetics and methodology of batch and continuous bioreactors. Sterilization of bioreactors: fibrous filter sterilization; Aeration and agitation: agitation in shake flask and tube rollers.

MB404-6A: INDUSTRIAL MICROBIOLOGY (PRACTICAL)

SEMESTER-V

Total hours: 30 Hrs **Credits: 2**

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

Suggested readings

1. Casida LE. (1991). **Industrial Microbiology**. 1st edition. Wiley Eastern Limited.
2. Crueger W and Crueger A. (2000). **Biotechnology: A textbook of Industrial Microbiology**. 2nd Edition. Panima Publishing Company, New Delhi
3. Patel AH. (1996). **Industrial Microbiology** .1st Edition. MacMillan India Limited Publishing Company Ltd. New Delhi, India
4. Stanbury PF, Whitaker A and Hall SJ. (2006). **Principles of Fermentation Technology.** 2nd edition, Elsevier Science Ltd.
5. Tortora GJ, Funke BR, and Case CL. (2008). **Microbiology: An introduction**. 9th Edition. Pearson Education

B.Sc, MICROBIOLOGY (CBCS) REVISED SYLLABUS (W.E.F. 2020-21)

MB 404-7A: MANAGEMENT OF HUMAN MICROBIAL DISEASES AND DIAGNOSIS

SEMESTER- V

TOTAL HOURS: 60 **CREDITS: 4**

Course Outcomes:

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

1. List, discuss and differentiate about some pathogenic organisms affecting human body systems.
2. Explain types of modes of disease transmission, distinguish between methods of disease prevention and control.
3. Distinguish different pathogens based on their morphological and biochemical characteristics
4. Identify pathogenic organisms by serological methods
5. Determine sensitivity of pathogenic organisms to various antimicrobials

UNIT I **No. of Hours: 12**

Definition and concept of health, disease, infection, and pathogen. Bacterial, Viral, Fungal and Protozoan Diseases of various human body systems- Bacterial diseases: *Staphylococcus aureus, Haemophilus influenzae, Neisseria gonorrhoeae*; Viral diseases: SARS CoV-2, Polio Virus; Fungal disease: *Candida albicans*; Protozoan disease: *Entamoeba histolytica.*

UNIT- II **No. of hours: 12**

General account of epidemiology: principles of epidemiology, current epidemics (AIDS, nosocomial, acute respiratory syndromes). Collection of clinical samples (oral cavity, throat, skin, blood, CSF, urine and faeces) and precautions required. Method of transport of clinical samples to laboratory and storage

UNIT- III **No. of hours: 12**

Mechanism of bacterial pathogenicity, colonization and growth, virulence, virulence factors, exotoxins, enterotoxins, endotoxins and neurotoxins. Examination of sample by staining - Gram stain, Ziehl-Neelson staining for tuberculosis, Giemsa-stained thin blood film for malaria. Preparation and use of culture media - Blood agar, Chocolate agar, Lowenstein-Jensen medium, MacConkey agar, Distinct colony properties of various bacterial pathogen

UNIT- IV **No. of hours:12**

Serological Methods - Agglutination, ELISA, immunofluorescence, Nucleic acid based methods - PCR, Nucleic acid probes. Diagnosis of Typhoid, Dengue and HIV, Swine flu. Role of vectors- biology of vectors. (1) House fly (2) Mosquitoes (3) sand fly.

UNIT- V **No. of hours: 12**

Importance, Determination of resistance/sensitivity of bacteria using disc diffusion method, Determination of minimal inhibitory concentration (MIC) of an antibiotic by serial double dilution method. Epidemiological investigations to identify a disease, Problems of drug resistance and drug sensitivity. Drug resistance in bacteria

MBP-404 7A: MANAGEMENT OF HUMAN MICROBIAL DISEASES AND DIAGNOSIS (PRACTICAL)
SEMESTER-V

1. Demonstration of permanent slides of the following parasites:
    a) *Entamoeba histolytica*
    b) *Ascaris spps.*
    c) *Plasmodium spps.*
    d) Mycobacterium tuberculosis & Mycobacterium leprae
2. Estimation of hemoglobin (Acid hematin and cyan methanoglobin method).
3. ESR and PCV determination.
4. Immuno hematology: Blood group typing by slide test & tube for ABO & Rh systems.
5. Isolation of bacteria in pure culture and Antibiotic sensitivity.

SUGGESTED READINGS

1. Ananthanarayan R and Paniker CKJ (2009) Textbook of Microbiology, 8th edition, Universities Press Private Ltd.
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelbergís Medical Microbiology. 26th edition. McGraw Hill Publication.
3. Collee JG, Fraser, AG, Marmion, BP, Simmons A (2007) Mackie and Mccartney Practical Medical Microbiology, 14th edition, Elsevier.
4. Randhawa, VS, Mehta G and Sharma KB (2009) Practicals and Viva in Medical Microbiology 2ndedition, Elsevier India Pvt Ltd.
5. Tille P (2013) Baileyís and Scottís Diagnostic Microbiology, 13th edition, Mosby.