Dr. V. S. KRISHNA GOVT. DEGREE COLLEGE (AUTONOMOUS)

MADDILAPALEM, VISAKHAPATNAM – 530 013

B. Sc MICROBIOLOGY (CBCS) SYLLABUS (W.E.F 2021 - 22)

FIRST YEAR – SEMESTER – I

COURSE – 1 INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY

TOTAL HOURS: 60 **CREDITS: 4**

Course outcomes: Upon completion of the course, the student will be able to achieve the following outcomes:

Cos	Course Outcomes
1.	Gain knowledge about growth of Microbiology discipline and prominent contributions of various scientists to the field of Microbiology
2.	Able to explain the useful and harmful activities of the microorganisms
3.	Acquired knowledge about classification of living organisms by various methods
4.	Understand the principles that underlie sterilization of culture media, glassware and plastic ware to be used for microbiological work
5.	Apply the skills of sterilization for aseptic culturing and microscopy techniques for studying different types of microorganisms
6.	Perform experiments involving pure culture isolation, propagation and preservation of microorganism in the laboratory
7.	Understand the nutritional requirements of microorganisms and measure microbial growth by direct and indirect techniques
8.	Identify various components of bacterial cells such as cell wall, cell membrane, capsule, pili, flagella and understand the nature and multiplication of plant and animal viruses
9.	Identify commonly available groups of microorganisms such as actinomycetes, spirochetes and chlamydia based on their characteristics
10.	Understood the chemical nature of viruses, types of viruses infecting animals, plants and bacteria (bacteriophages) and their mechanism of multiplication.

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

HISTORY OF MICROBIOLOGY & SYSTEMATICS: History and major mile stones in microbiology; Contributions of Anton von Leeuwenhoek, Edward Jenner, Louis Pasteur, Robert Koch, Dmitri Ivanovsky; Importance and applications of microbiology in Food, Medicine, Industry and Environment.

Classification of microorganisms – Haeckel's three Kingdom concept, Whittaker's five kingdom concept, three domain concept of Carl Woese.

UNIT – II **No. of hours: 12**

TECHNIQUES IN MICROBIOLOGY: Methods of sterilization – Physical methods [dry heat (Bunsen burner, hot air oven), moist heat (autoclave), radiation (UV rays, γ-rays), and filtration methods (laminar air flow)], Chemical methods (alcohols, aldehydes, hypochlorites, Phenols and halogens).

Principles of microscopy – Bright field, Dark field, Phase contrast and Electron microscopy (SEM & TEM); Staining techniques – Simple and differential staining (Gram's and endospore staining).

UNIT – III **No. of hours: 12**

MICROBIAL MEDIA, CULTURE AND PRESERVATION TECHNIQUES: Nutritional types of bacteria (Photoautotrophs, Photoheterotrophs, Chemoautotrophs, Chemoheterotrophs); Microbiological media – Liquid, Solid, Natural, Synthetic, Defined, Complex, Enriched, Selective, Differential, Maintenance, Transport, Anaerobic media; Microbial culture methods – Obtaining pure cultures by isolation, enrichment, streak plate method; Preservation of microbial cultures – Subculturing, overlaying with mineral oil, lyophilization and storage at low temperatures.

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

MICROBIAL GROWTH: Requirement for growth – Physical (temperature, pH, osmotic pressure) and chemical requirements (carbon, nitrogen, phosphorous, Sulphur, trace elements), phases of growth, growth curve; Binary fission, endospore formation.

Methods of measuring growth – Direct methods (plate count, filtration, most probable number (MPN), direct microscopic count), Indirect methods (turbidity, metabolic activity, dry weight)

UNIT –V **No. of hours: 12**

BACTERIA AND VIRUSES: Ultrastructure of prokaryotic cell – Variant components (Capsule, fimbriae, pili, endospore and storage granules) and invariant components (cell

membrane, ribosomes, nucleoid). Cell wall of bacteria (Gram positive and Gram negative) and fungi. General characters of Actinomycetes, Spirochetes, Rickettsia, Mycoplasma and Chlamydia. General characters of viruses, Morphology, Structure and replication of TMV and HIV.

ADDITIONAL INPUTS:

1. Differentiation of prokaryotes and eukaryotes

2. Outline of classification of bacteria by Bergey's Manual of Systematic Bacteriology.

3. Buffers and solutions preparation based on percentage, normality, and molarity.

PRACTICAL-1 INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY

TOTAL HOURS: 30 **CREDITS: 2**

1. Microbiology Good Laboratory Practices and Biosafety.
2. Preparation of culture media for cultivation of bacteria
3. Preparation of culture media for cultivation of fungi
4. Sterilization of medium using Autoclave
5. Sterilization of glassware using Hot Air Oven
6. Light compound microscope and its handling
7. Microscopic observation of bacteria (Gram +ve bacilli and cocci, Gram -ve bacilli), Cyanobacteria, Algae and Fungi.
8. Simple staining
9. Gram's staining
10. Hanging-drop method.
11. Isolation of pure cultures of bacteria by streaking method.
12. Preservation of bacterial cultures by various techniques.

SUGGESTED READING

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. Power, C.B. and Daginawala, H.F. (1986). **General Microbiology** Vol I & II
4. Prescott, M.J., Harley, J.P. and Klein, D.A. (2010). **Microbiology**. 5th Edition, WCB McGrawHill, New York.
5. Reddy, S.M. and Reddy, S.R. (1998). **Microbiology - Practical Manual**, 3rd Edition, Sri Padmavathi Publications, Hyderabad.
6. Singh, R.P. (2007). **General Microbiology**. Kalyani Publishers, New Delhi.
7. Stanier, R.Y., Adelberg, E.A. and Ingram, J.L. (1991). **General Microbiology**, 5th Ed., Prentice Hall of India Pvt. Ltd., New Delhi.
8. Madigan, M.T., Martinkl, J.M. and Parker, J. (2010). **Brock Biology of Microorganisms,** 9th Edition, MacMillan Press, England.
9. Jaya Babu (2006). **Practical Manual on Microbial Metabolisms and General Microbiology**. Kalyani Publishers, New Delhi.
10. Gopal Reddy *et al.,* **Laboratory Experiments in Microbiology**.

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FIRST YEAR – SEMESTER- 2

COURSE-2 MICROBIAL PHYSIOLOGY AND BIOCHEMISTRY

TOTAL HOURS: 60 **CREDITS: 4**

Course outcomes: Upon completion of the course, the student will be able to achieve the following outcomes:

Cos	Course Outcomes
1.	Develop an idea of how carbohydrates function as structural, energy generation and energy storage entities in living cells
2.	Discover how various classes of lipids are part of cell and body's structural, functional components and energy reserves
3.	Become aware of the multifarious function of proteins, understand various levels of protein structure and evaluate the relationship between structure and function
4.	Understand the DNA structure and function and interpret how DNA
5.	Several separation techniques which may be required to be handled later as microbiologists
6.	Describing the growth characteristics of the microorganisms capable of growing under unusual environmental condition of temperature, oxygen, and solute and water activity
7.	Describing the growth characteristics of the microorganisms which require different nutrient for growth and the associated mechanisms of energy generation for their survival like autotrophs, heterotrophs, chemolithoautotrophs etc.
8.	Differentiating concepts of aerobic and anaerobic respiration and how these are manifested in the form of different metabolic pathways in microorganisms
9.	Describe the nutritional requirements of bacteria for growth; developed knowledge and understanding that besides common bacteria there are several other microbes which grow under extreme environments
10.	Calculate generation time of growing bacteria

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

BIOMOLECULES I: Carbohydrates – Classification of carbohydrates with examples, properties, and functions of carbohydrates; Structure of monosaccharides (glucose, fructose), disaccharides (lactose, sucrose), and polysaccharides – homo (starch, glycogen) and heteropolysaccharides (Agar, pectin). Lipids – classification of lipids with examples, properties, and function of lipids, saturated and unsaturated fatty acids, triglycerides, phospholipids, glycolipids, cholesterol& waxes.

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

BIOMOLECULES II: Amino acids – classification of amino acids, Functions of amino acids. Proteins – properties and functions of proteins. Structural levels of proteins– primary, secondary, tertiary, and quaternary. Nucleic acids – properties and functions of nucleic acids; Watson and Crick structure of DNA, forms of DNA (A-form, B-form and Z-form). Structure of RNA.

UNIT – III: **No. of hours: 12**

ENZYMES: Properties and classification of Enzymes. Induced fit theory. Lock and key hypothesis. Coenzymes and Cofactors. Factors affecting catalytic activity (effectofsubstrateconcentration,enzymeconcentration, pHandtemperature). Inhibition of enzyme activity- competitive, noncompetitive, uncompetitive and allosteric. Microbial enzymes of industrial and medical importance.

UNIT – IV: **No. of hours: 12**

MICROBIAL METABOLISM I: Aerobic respiration – Substrate level phosphorylation; amphibolic pathways; Glycolysis, HMP shunt, ED path way, PPP pathway, TCA cycle, Electron transport Chain and oxidative phosphorylation. Glyoxylate cycle;Gluconeogenesis.

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

MICROBIAL METABOLISM II: Anaerobic respiration – Nitrate and sulphate respiration. Fermentation – Lactic acid and ethanol, fermentations. Photosynthesis – photosynthetic apparatus in bacteria; Oxygenic photosynthesis, anoxygenic photosynthesis; Assimilation of CO_2.

ADDITIONAL INPUTS

1. Centrifugation
2. Chromatography
3. Electrophoresis

Practical - 2: MICROBIAL PHYSIOLOGY AND BIOCHEMISTRY

TOTAL HOURS: 48 **CREDITS: 2**

1. Principle and applications of colorimeter.

2. Principal and applications of paper chromatography.

3. Colorimetric estimation DNA by diphenylamine method.

4. EstimationofRNAbyOrcinolmethod.

5. Colorimetric estimation of proteins by Biuret / Lowry method.

6.Estimation of reducing sugar-Anthrone method.

7. Estimation of sugar by titration method–Benedict's method.

8. Determination of pKa and pI values of amino acids.

9. Assay of amylase activity

10. Effectoftemperature/pH on enzymeactivity

11. Demonstration of immobilization of enzyme activity.

SUGGESTED READING:

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

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SECOND YEAR – SEMESTER – III

COURSE – 3 :MOLECULAR BIOLOGY AND MICROBIAL GENETICS

TOTAL HOURS: 60 **CREDITS: 4**

Course outcomes: Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes
1.	Understand the differences in genomic organization of prokaryotes and eukaryotes and functions of extrachromosomal elements
2.	Apply the knowledge of DNA structure and replication to match different antibiotics with their mechanism of action against bacteria.
3.	Apply the knowledge of transcription and translation to correlate the antibiotic with their mode of action against bacterial pathogens.
4.	Study the Genetic code and understandits salient properties and exceptions
5.	Apply the knowledge of mutation and mutagens to artificially induce mutations in laboratory.
6.	Appreciate the effect of mutagens on DNA damage and the natural DNA repair mechanisms in bacteria
7.	Understand the concept of gene, gene expression and DNA recombination methods of bacteria.
8.	Evaluate the relation between gene and protein through various hypothesis
9.	Acquaint themselves with the knowledge ofcistron and mechanisms of gene regulation in prokaryotes.
10.	Familiarize themselves with positive vs negative regulation, inducible vs repressible operons.

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

DNA REPLICATION: Discovery of DNA as genetic material. Structure and organization of prokaryotic and eukaryotic DNA. Extrachromosomal genetic elements – plasmids and transposons. DNA Replication – Enzymes and proteins of DNA replication, Semiconservative mechanism of DNA replication and inhibitors of DNA replication.

UNIT – II **No. of hours: 12**

TRANSCRIPTION: RNA classes – properties, structure and functions. RNA polymerases of *E. coli*and eukaryotes. Mechanism of transcription in prokaryotes and eukaryotes. Post-transcriptional modifications. Inhibitors of transcription. **TRANSLATION**: Genetic code, Wobble hypothesis, Ribosomes – structure and function; Mechanism of translation in prokaryotes and eukaryotes, post-translational modification, Inhibitors of translation.

UNIT – III **No. of hours: 12**

MUTATIONS AND DNA REPAIR: Mutations – Spontaneous and induced. DNA mutations (base substitution, deletion and insertions), Point mutation (silent, missense, nonsense and frameshift) and chromosomal mutations (deletion, insertion, duplication, inversion, monosomy, trisomy). Mutagens – types and properties. DNA damage. DNA repair mechanisms – Base excision repair and Nucleotide excision repair.

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

BACTERIAL GENETICS: Concept of gene, Muton, Recon and Cistron. One gene – one enzyme and one gene – one polypeptide hypothesis. Genetic recombination in bacteria – Conjugation, Transformation and Transduction – generalized and specialized transduction.

UNIT –V **No. of hours: 12**

GENE REGULATION: Types of genes – structural, constitutive and regulatory genes, mono and poly-cistronic genes. Regulation of gene expression in bacteria – Concept of operon, *lac* operon (inducible), *trp* operon (repressible).

ADDITIONAL INPUTS:

1. Arabinose operon
2. Gene regulation in eukaryotes
3. Transcription factors

Practical 3: MOLECULAR BIOLOGY AND MICROBIAL GENETICS

TOTAL HOURS: 48 **CREDITS: 2**

1. Study of different types of DNA and RNA using micrographs and model/ schematic representation.
2. Study of semi-conservative replication of DNA through micrographs/ schematic representations.
3. Isolation of genomic DNA from *E. coli*.
4. Estimation of DNA concentration by UV spectrophotometer
5. Resolution and visualization of DNA by agarose gel electrophoresis
6. Resolution and visualization of proteins by polyacrylamide gel electrophoresis
7. Induction of mutations in bacteria by UV light
8. Principle and working of – Ultracentrifuge, Transilluminator, PCR.

SUGGESTED READING

1. Crueger, W. and Crueger, A. (2000). **Biotechnology: A Text Book of Industrial Microbiology,** Prentice Hall of India Pvt. Ltd., New Delhi.
2. Freifelder, D. (1990). **Microbial Genetics**. Narosa Publishing House, New Delhi.
3. Freifelder, D. (1997). **Essentials of Molecular Biology**. Narosa Publishing House, New Delhi.
4. Glazer, A.N. and Nikaido, H. (1995). **Microbial Biotechnology – Fundamentals of Applied Microbiology**, W.H. Freeman and company, New York.
5. Glick, B.P. and Pasternack, J. (1998). **Molecular Biotechnology**, ASM Press, Washington D.C., USA.
6. Kannan, N. (2003). **Hand Book of Laboratory Culture Medias, Reagents, Stains and Buffers**. Panima Publishing Co., New Delhi.
7. Lewin, B. (2000). **Genes VIII.** Oxford University Press, England
8. Maloy, S.R., Cronan, J.E. and Freifelder, D. (1994). **Microbial Genetics**, Jones and Bartlett Publishers, London.
9. Nicholl, D.S.T. (2004). **An Introduction to Genetic Engineering.** 2nd Edition. Cambridge University Press, London.

10. Ram Reddy, S., Venkateshwarlu, K. and Krishna Reddy, V. (2007) **A text Book of Molecular Biotechnology**. Himalaya Publishers, Hyderabad.
11. Sinnot E.W., L.C. Dunn and T. Dobzhansky. (1958). **Principles of Genetics**. 5 th Edition. McGraw Hill, New York.
12. Snyder, L. and Champness, W. (1997). **Molecular Genetics of Bacteria**. ASM press,
13. Strickberger, M.W. (1967). **Genetics**. Oxford & IBH, New Delhi.
14. Turner, P.C., Mclennan, A.G., Bates, A.D. and White, M.R.H. (1998). **Instant Notes in Molecular Biology**, Viva Books Pvt., Ltd., New Delhi.

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SECOND YEAR – SEMESTER- 4

COURSE-4 IMMUNOLOGY AND MEDICAL MICROBIOLOGY

TOTAL HOURS: 60 **CREDITS: 4**

Course outcomes: Upon completion of the course, the student will be able to achieve the following outcomes:

Cos	Course Outcomes
1.	Able to differentiate between innate vs adaptive immunity, active vs passive immunity and understand the contributions of the organs and cells in immune responses.
2.	Identify the role of antigen presenting cells, lymphocytes, and phagocytic cells in immune responses.
3.	Understand the mechanisms involved in initiation of specific immune responses and differentiate the humoral and cell mediated immune mechanisms
4.	Display a comprehensive and practical understanding of basic immunological principles involved in research and clinical/ applied science.
5.	Know about the normal microbial flora of human and learn about the characters, pathogenicity, lab diagnosis of bacteria pathogens.
6.	Learn cultural, biochemical, immunological and molecular diagnostic tests and assays against pathogens.
7.	Understand the principles of disease epidemiology, pathogenesis, diagnosis and treatment of different infectious diseases.
8.	Gain knowledge about the basic information of microbial pathogens and protozoan parasites.
9.	An in-depth study of different antibiotics from the viewpoint of targets, resistance mechanisms and spectrum evaluation methods.
10.	Explain the mechanisms and differences between primary and secondary responses and their relevance to vaccinations.

UNIT – I: **No. of hours: 12**

IMMUNE SYSTEM: Immunity - Types of immunity - innate and acquired; active and passive; humoral and cell-mediated immunity. Herd immunity.

Lymphoid organs of immune system - Primary (Thymus, Bursa of Fabricius, bone marrow)

and Secondary (spleen, lymph nodes and MALT) lymphoid organs. Cells of immune system – Function of B- and T-lymphocytes, null cells, monocytes, macrophages, neutrophils, basophils, and eosinophils.

UNIT – II: **No. of hours: 12**

ANTIBODY TECHNIQUES: Antigens - types, chemical nature, antigenic determinants, haptens. Factors affecting antigenicity.

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

Types of antigen-antibody reactions – Agglutination (blood grouping), Precipitation (Ouchterlony double diffusion test), Neutralization (Viral Hemagglutination), Flocculation (VDRL test) and complement fixation test.

Labeled antibody-based techniques - ELISA, RIA and Immunofluorescence. Polyclonal antibodies. Production of monoclonal antibodies by Hybridoma technology. Applications of Monoclonal antibodies.

Hypersensitivity – Outlines of types of Hypersensitivity with examples. Autoimmunity.

UNIT – III: **No. of hours: 12**

HOST PATHOGEN INTERACTIONS AND CLINICAL MICROBIOLOGY: Normal flora of human body.Host pathogen interactions: infection, invasion, pathogen, pathogenicity, virulence and opportunistic infection.General account on nosocomial infection.General principles of diagnostic microbiology- collection, transport and processing ofclinical samples.General methods of laboratory diagnosis - cultural, biochemical, serological and molecularmethods.

UNIT – IV: **No. of hours: 12**

MICROBIAL AND PARASITIC DISEASES: General account on microbial diseases - causal organism, pathogenesis, epidemiology,diagnosis, prevention and control**.**

Bacterial diseases – Tuberculosis; Typhoid

Fungal diseases – Candidiasis; Aspergillosis

Protozoal diseases – Malaria; Filaria

Viral Diseases - Hepatitis- A; AIDS.

UNIT – V: **No. of hours: 12**

CHEMOTHERAPEUTIC AGENTS AND VACCINES: Principles of chemotherapy – selective toxicity, spectrum of toxicity, therapeutic dose and concentration of drug – bacteriostatic & bactericidal. Mode of action of antimicrobial drugs.Antibacterial drugs – Penicillin, Antifungal drugs – Nystatin, Antiviral agents – interferon and base analogues.Drug resistance in bacteria. Antibiotic susceptibility testing methods. Vaccines – Live, killed, subunit, recombinant and DNA vaccines.

Practical-4: IMMUNOLOGY AND MEDICAL MICROBIOLOGY

TOTAL HOURS: 48 **CREDITS: 2**

1. Identification of human blood groups.
2. Separate serum from the blood sample (demonstration).
3. Estimation of blood hemoglobin.
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 READING:

1. Ananthanarayan R and Paniker C.K.J. (2009) **Textbook of Microbiology**. 8th edition, University Press Publication.
2. Jawetz, Melnick and Adelberg's **Medical Microbiology**. 26th edition. McGraw Hill Publication.
3. Delves P, Martin S, Burton D, Roitt IM. (2006). **Roitt's Essential Immunology**.11th edition Wiley-Blackwell Scientific Publication, Oxford.
4. Goldsby RA, Kindt TJ, Osborne BA. (2007). **Kuby's Immunology**. 6th edition W.H. Freeman and Company, New York.
5. **Kuby's Immunology**. 6th edition W.H. Freeman and Company, New York.
6. Jawetz, Melnick and Adelberg's **Medical Microbiology**. 26th edition. McGraw Hill
7. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's **Microbiology**. 9th edition. McGraw Hill Higher Education.
8. R. P. Singh, 2019. **Immunology And Medical Microbiology**. Kalyani Publishers.

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SECOND YEAR – SEMESTER- 4

COURSE-5 FOOD AND INDUSTRIAL MICROBIOLOGY

TOTAL HOURS: 60 **CREDITS: 4**

Course outcomes: Upon completion of the course, the student will be able to achieve the following outcomes:

Cos	Course Outcomes
1.	Understand food as a suitable habitat for growth of microorganisms
2.	Become aware of microbial characteristic desirable to the food industry and their roles in food production, food spoilage, and food-borne illnesses.
3.	Explain the principles involved in microbial control, conventional and new methods of preserving foods, probiotics and useful microorganism in food.
4.	Well versed with nutritional benefits of varied microbe foods such as single cell proteins, mushrooms and probiotics.
5.	Understand the economic importance of different categories of microbes to food, pharma and allied industries.
6.	Appreciate the importance of screening microorganisms producing primary and secondary metabolites with industrial and economic importance.
7.	Describe the principles and applications of batch and continuous fermentation processes
8.	Explain the procedures applied in purification of any industrial product from fermentation media.
9.	Describe the applications of microbial enzymes in manufacturing of detergents, textiles, leather, and mining applications.
10.	List some of the important metabolites from microbial metabolism along with their applications.

UNIT – 1 **No. of Hours: 12**

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

UNIT – II **No. of Hours: 12**

FOOD PRESERVATION AND MICROBES AS FOOD: 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). Probiotics and their benefits.

UNIT – III **No.of hours: 12**

INDUSTRIAL MICROBES AND MICROBIAL METABOLITES: Microorganisms of industrial importance – yeasts (*Saccharomyces cerevisiae*),molds (*Aspergillus niger*), bacteria (*E.coli*), actinomycetes(*Streptomyces griseus*).Primary and secondary microbial metabolites. Screening techniques - Techniques involved in selection of industrially important metabolites from microbes.

UNIT – IV **No. of hours: 12**

FERMENTATION AND DOWNSTREAM PROCESSING: Basic concepts of Design of fermenter. Types of fermenters – batch, continuous and fed batch. Types of fermentation processes – solid state, liquid state. Principles of production media, components of media, chemical composition of fermentation media. Downstream processing - filtration, centrifugation, cell disruption, solvent extraction.

UNIT – V **No. of hours: 12**

INDUSTRIAL MICROBIOLOGY: Microorganisms involved in Pharma and therapeutic enzymes. Microbial enzymes used in detergents, textiles and leather industries. Industrial production of Amylases and Proteases. Microbial therapeutic enzymes. Microbial production of Industrial products: Citric acid, Ethanol, Penicillin, Glutamic acid, and vitamin B12.

Practical – 5:FOOD AND INDUSTRIAL MICROBIOLOGY

Total hours: 36 **Credits: 1**

1. 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 ethanol from grapes
10. Microbial fermentation for the production and estimation of citric acid

Suggested Readings

1. Frazier,W.C. and Westhoff, D. C. 2004. **Food Microbiology**. 3rd McGraw Hill, New Delhi.
2. Jay, J. M. 1992. **Modern Food Microbiology**. 4th Van Nostrand Reinhold, New York, USA.
3. Okafor, N. 2007. **Modern Industrial Microbiology and Biotechnology**. Enfield: Science Publ., USA.
4. Ray, B. 2004. **Fundamental Food Microbiology** 3rd, CRC Press, Washington D.C. USA.
5. Waites, M. J. 2001. **Industrial Microbiology: An Introduction**. Blackwell Science, London.

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FINAL YEAR – SEMESTER- 5/6

COURSE-6A AGRICULTURAL AND ENVIRONMENTAL MICROBIOLOGY

TOTAL HOURS: 60 **CREDITS: 4**

Course outcomes: Upon completion of the course, the student will be able to achieve the following outcomes:

Cos	Course Outcomes
1.	Learn about the microbial groups involved in mineral recycling and soil fertility
2.	To know the complex interaction between agriculture system and micro-organism.
3.	Understand the beneficial activities of microbes in soil for plant growth promotion
4.	To introduce micro-organism in agricultural system for building a pathway for sustainable agriculture
5.	Study the types of diseases caused to the plants and their control in various manners
6.	To understand the diseases pathogenesis in plants system for effective plant disease management.
7.	Explore soil, aquatic, atmospheric and extreme environments, and the microorganisms ofthat area
8.	Know the microbial analysis of drinking water and aeromicrobiology
9.	Understand waste, disposal methodsand methods of recycling and investigate the contaminants
10.	Knowthe different aspects of waste management and sewage Treatment systems, biosafety and environmental monitoring regulations.

UNIT – I **No. of Hours: 12**

SOIL MICROBIOLOGY: Microbial groups in soil, microbial transformations of Carbon, Nitrogen, Phosphorus and Sulphur.Biological Nitrogen fixation. Microflora of Rhizosphere and Phyllosphere, microbes in composting. Production of VAM, field applications of Ectomycorrhiza and VAM.

UNIT – II **No.of Hours: 12**

BENEFICIAL MICROORGANISMS IN AGRICULTURE: Biofertilizer (Bacterial, Cyanobacterial and Fungal), microbial insecticides, Microbial agents for control of Plant diseases (*Bacillus thuringiensis*), Plant – Microbe interactions - mutualism, commensalism, antagonism, competition, parasitism, predation.

Management of soil biota for maintaining soil fertility. Conversion of waste lands into fertile lands.Management of soil nutrients.

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

DISEASES IN PLANTS: Concept of disease in plants. Symptoms of plant diseases caused by fungi, bacteria, and viruses. Plant diseases - groundnut rust, Citrus canker and tomato leaf curl.

Principles of plant disease control.

UNIT – IVNo. of Hours: 12

TERRESTRIAL ENVIRONMENT: Soil profile and soil microflora. Aquatic Environment: Microflora of fresh water and marine habitats. Atmosphere: Aero microflora and dispersal of microbes. Extremophiles. Nutrient cycling - Carbon, nitrogen, phosphorus.Biodegradation, Biogas production, Biodegradable plastics,

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

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, and tertiary sewage treatment.Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive test/MPN test, confirmed and completed tests for fecal coliforms (b) Membrane filter technique.

Practical 6A – AGRICULTURE AND ENVIRONMENTAL MICROBIOLOGY

Total hours: 40 **Credits: 1**

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 micro flora
6. Isolation of *Rhizobium* from root nodules.
7. Isolation of *Azotobacter* 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 Petri plate exposure method.
12. Analysis of potable water: SPC, Presumptive, confirmed and completed test, determination of coliform counts 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. Madigan MT, Martinko JM and Parker J. (2014). **Brock Biology of Microorganisms**. 14th edition. Pearson/ Benjamin Cummings.
6. Maier RM, Pepper IL and Gerba CP. (2009). **Environmental Microbiology**. 2nd edition, Academic Press.
7. Martin A. (1977). **An Introduction to Soil Microbiology**. 2nd edition. John Wiley & Sons Inc. New York & London.
8. Subba Rao NS. (1999). **Soil Microbiology**. 4th edition. Oxford & IBH Publishing Co. New Delhi.
9. Willey JM, Sherwood LM, and Woolverton CJ. (2013). **Prescott's Microbiology**. 9th edition. McGraw Hill Higher Education.

Dr. V. S. KRISHNA GOVT. DEGREE COLLEGE (AUTONOMOUS)

MADDILAPALEM, VISAKHAPATNAM

B.Sc. MICROBIOLOGY (CBCS) SYLLABUS (W.E.F.2021-22)

FINAL YEAR – SEMESTER- 5/6

COURSE-7A: CLINICAL MICROBIOLOGY

TOTAL HOURS: 60 **CREDITS: 4**

Course outcomes: Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes
1.	Deep understanding of the disease cycles and their outbreaks
2.	Gaining theoretical knowledge of most common disease-causing organisms
3.	Enumerating the methods and vehicles of disease transmission
4.	Understanding the basics of Clinical laboratory protocols
5.	Systematic knowledge on the pathogenesis and laboratory diagnosis of diseases
6.	Developing insights into clinical practices and serological techniques.
7.	Gain knowledge on advanced techniques and diagnosis
8.	Identify the blood groups and estimate the concentration of Hemoglobin
9.	Develop knowledge on antimicrobial sensitivity and resistance mechanism
10.	Perform antibiotic sensitivity tests of some antibiotics on few organisms

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

TYPES OF DISEASES: Disease - incidence, prevalence; communicable, non-communicable; frequency of occurrence (sporadic, endemic, epidemic, pandemic), severity /duration of disease(acute, chronic, latent); development of disease; the spread of infection(human reservoirs, animal reservoirs, non-living reservoirs); transmission of disease (contact (direct, indirect, droplet); vehicle (water, food, air, vectors(mechanical, biological); portals of entry(mucus

membrane, skin, parenteral route) & portals of exit. Herd immunity. Control of disease transmission.

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

TYPES OF INFECTIONS: Description of pathogenesis, etiology and laboratory diagnosis of the following:

Respiratory infections – Pneumonia, Influenza

Food and water borne infections – cholera, polio

Urinary tract and Gastro intestinal infections (*E.coli*)

Central Nervous System infections (meningitis, encephalitis)

Sexually transmitted diseases: Treponema, Neisseria.

Blood stream infections – Bacteraemia

UNIT – III **No. of Hours:12**

IDENTIFICATION OF ORGANISMS: Microscopic examination of specimen for Bacterial pathogens – simple staining, Gram staining and motility by Hanging drop method.

Biochemical reaction – Sugar fermentation test,

Cultural tests- IMVIC tests (Indole test, methyl red test, Voges- Proskauer test and Simon Citrate agar test)

Determination of antibiotic sensitivity – Qualitative methods (Kirby Bauer's Method; Stokes method) and quantitative methods (Tube dilution and agar dilution methods). E-test.

UNIT – IV **No. of Hours:12**

CLINICAL LAB TECHNOLOGY: Collection of clinical samples (oral cavity, throat, skin, blood, CSF, urine, and feces) and precautions required. Method of transport of clinical samples to laboratory and storage.

Observation of blood cells – preparation of blood smear, Leishman staining, Giemsa & Wright staining, bleeding time(BT), clotting time(CT).

Microscopic observation of Bacteria and yeast, Casts, Epithelial cells,Crystals, Red blood cells and White blood cells in urine sample.

UNIT – VNo. of Hours:12

SEROLOGY: Antigen - antibody reactions – Agglutinations (blood grouping, WIDAL test) Hemagglutination, Flocculation (VDRL test), Complementation fixation test, Ouchterlony double diffusion test, Rocket immunoelectrophoresis. ELISA and RIA. RT-PCR; Western blot analysis for HIV. HCG pregnancy test.

Practical – 7A: CLINICAL MICROBIOLOGY

TOTAL HOURS: 40 **CREDITS: 1**

1. Collection transport and processing of clinical specimens (Blood, Urine, Stool and Sputum). Receipts, Labeling, recording, and dispatching clinical specimens.
2. Examination of urine for pathogenic microorganisms –collection of urine, microscopic examination of urine.
3. Isolation and identification of Escherichia coli, Klebsiella pneumonia from urine samples.
4. Mycology – Direct microscopy – cultures using Sabouraud's Dextrose agar medium, Wet mount preparations using Lactophenol cotton blue/KOH mount.
5. Estimation of hemoglobin (Acid hematin and cyanmethemoglobin method).
6. Immunohematology: Blood group typing by slide test & tube for ABO & Rh systems.
7. Determination of Antibiotic sensitivity Test by Kirby Bauer's method.
8. Study of various concentration of an antibiotic on any 2 bacteria by E-test.
9. RBC and WBC count
10. Bleeding time and Clotting time

SUGGESTED READING

1. Ananthanarayan R and Paniker CKJ (2009) **Textbook of Microbiology**, 8th edition, Universities Press Private Ltd.
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's **Medical Microbiology**. 26th edition. McGraw Hill Publication.
3. 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** 2nd edition, Elsevier India Pvt Ltd.
5. Tille P (2013) Bailey's and Scott's **Diagnostic Microbiology**, 13th edition, Mosby.
6. Tortora, G.J., Funke, B.R. and Case, C.L. (2010) **Microbiology: An Introduction**. 10th Edition, Pearson Benjamin Cummings, San Francisco.