**DR.V.S.KRISHNA GOVT. DEGREE & PG COLLEGE(A)**

**VISAKHAPATNAM**

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**BOARD OF STUDIES 2020-21**

**MICROBIOLOGY**

**REVISED SYLLABUS OF MICROBIOLOGY UNDER CBCS FRAMEWORK**

**WITH EFFECT FROM 2020-2021 PROGRAMME**

**DEPARTMENT OF MICROBIOLOGY**

 **(SYLLABUS, MODEL PAPER, BLUE PRINT, CREDITS, LIST OF EXAMINERS)**

**MICROBIOLOGY – COURSE WISE CREDITS W.E.F 2020-21**

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| Semester | Course | Title  | Hours | Marks | Credits |
| I | 1(T) | Introductory Microbiology & Microbial diversity | 4 | 75 + 25 | 4 |
|  | 1(P) | Introductory Microbiology & Microbial diversity | 2 | 50 | 1 |
| II | 2(T) | Microbial biochemistry & metabolism | 4 | 75 + 25 | 4 |
|  | 2(P) | Microbial biochemistry & metabolism | 2 | 50 | 1 |
| III | 3(T) | Microbial genetics & Molecular biology | 4 | 75 + 25 | 4 |
|  | 3(P) | Microbial genetics & Molecular biology | 2 | 50 | 1 |
| IV | 4(T) | Immunology & Medical Microbiology | 4 | 75 + 25 | 4 |
|  | 4(P) | Immunology & Medical Microbiology | 2 | 50 | 1 |
|  | 5(T) | Environmental & Agricultural Microbiology | 4 | 75 + 25 | 4 |
|  | 5(P) | Environmental & Agricultural Microbiology | 2 | 50 | 1 |

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

**MADDILAPALEM, VISAKHAPATNAM**

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

**FIRST YEAR – SEMESTER- I**

**COURSE-1 INTRODUCTORY MICROBIOLOGY AND MICROBIAL DIVERSITY**

**TOTAL HOURS: 60 CREDITS: 4**

**Course outcomes:** At the conclusion of this course the students –

CO 1 : Have developed a good knowledge of the development of the discipline of Microbiology

 and the contributions made by prominent scientists in this field.

CO 2 : Have developed a very good understanding of the characteristics of different types of

 microorganisms.

CO 3 : Are able to explain the useful and harmful activities of the microorganisms.

CO 4 : Describe characteristics of bacterial cells, cell organelles, cell wall composition and various

 appendages like capsules, flagella or pili.

CO 5: Understood what are viruses and the chemical nature of viruses, different types of viruses

 infecting animals, plants and bacteria (bacteriophages)

CO 6: Identify commonly available fungi and algae and their characteristics.

CO 7 : Are able to perform basic experiments to grow , study microorganisms and methods to

 preserve bacteria in the laboratory

CO 8 : Principles which underlies sterilization of culture media, glassware and plastic ware to be

 used for microbiological work.

CO 9 : Handling and use of microscopes for the study of microorganisms which are among the

 basic skills expected from a practicing microbiologist. They also get introduced a variety

 of modifications in the microscopes for specialized viewing.

**UNIT-I** **HISTORY OF MICROBIOLOGY & SYSTEMATICS No. of hours: 12**

History and mile stones in microbiology. Contributions of Anton von Leeuwenhoek, Edward Jenner, Louis Pasteur, Robert Koch, Ivanowsky. Importance and applications of microbiology.

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

Outline classification of bacteria as per the second edition of Bergey’s Manual of Systematic Bacteriology.

**UNIT – II** **BACTERIA & VIRUSES**  **No. of hours: 12**

General characteristics of Bacteria, Archaea, Mycoplasmas and Cyanobacteria.

Ultrastructure of a prokaryotic cell: Invariant components - Cell wall, cell membrane, ribosomes, nucleoid. Variant components - Capsule, fimbriae, pili, endospore and storage granules.

General characteristics of viruses.

Morphology, Structure and replication of TMV and HIV.

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

General characteristics and outline classification of Protozoa

General characteristics and outline classification of microalgae

General characteristics and outline classification of molds

General characteristics and outline classification of yeasts

**UNIT-IV PRINCIPLES OF MICROBIOLOGY No. of hours: 12**

Principles of microscopy - Bright field and Electron microscopy (SEM and TEM).

Staining Techniques –Simple and Differential (Gram Staining and Spore Staining).

Sterilization and disinfection techniques - Physical methods – autoclave, hot- air oven, pressure cooker, laminar air flow, filter sterilization, Radiation methods – UV rays, Gamma rays.

Chemical methods – alcohols, aldehydes, fumigants, phenols, halogens and hypochlorites.

**UNIT –V ISOLATION TECHNIQUES No. of hours: 12**

Growth media- synthetic, complex, selective, enrichment and differential media.

 Pure culture techniques – dilution-plating, Streak-plate, Spread-plate, Pour-Plate and micromanipulator. Enrichment culturing.

Preservation of microbial cultures – subculturing, overlaying cultures with mineral oils, lyophilization, sand cultures, storage at low temperature.

**Additional inputs:**

1. Differentiation of prokaryotes and eukaryotes

2. Definition & properties of a stain

3. Conditions required for culturing microbes & role of buffers

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| **PRACTICAL-1 INTRODUCTORY MICROBIOLOGY AND MICROBIAL DIVERSITY** |
| **TOTAL HOURS: 30**  **CREDITS: 1** |
| 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. Simple staining |
| 8. Gram’s staining |
| 9. Hanging-drop method. |
| 10. Isolation of pure cultures of bacteria by streaking method. |

**SUGGESTED READING**

Alexopoulos, C.J., Mims, C.W. and Blackwell, M. (1996). **Introductory Mycology**, Wiley, New York.

Atlas, R.A. and Bartha, R. (2000). Microbial Ecology . **Fundamentals and Application,** Benjamin Cummings, New York.

Dimmock, N.J., Easton, A.J. and Leppard, K.N. (2001). **Introduction to Modern Virology**, Blackwell Science Ltd, U.K.

Dubey, R.C. and Maheswari, D.K. (2000) **General Microbiology**. S Chand, New Delhi.

Edition), Himalaya Publishing House, Mumbai.

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Jaya Babu (2006). **Practical Manual on Microbial Metabolisms and General Microbiology**. Kalyani Publishers, New Delhi.

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Moore . Landecker, E. (1996). **Fundamentals of Fungi,** Prentice-Hall, NJ, USA.

Niclin, J. et al. (1999). **Instant Notes in Microbiology.** Viva Books Pvt. Ltd., New Delhi.

Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. (1993). **Microbiology.** 5th Edition, Tata Mc Graw Hill Publishing Co., Ltd., New Delhi.

Gopal Reddy et al Laboratory **Experiments in Microbiology**

Power, C.B. and Daginawala, H.F. (1986). **General Microbiology** Vol I & II (2nd

Prescott, M.J., Harley, J.P. and Klein, D.A. (2010). **Microbiology.** 5th Edition, WCB Mc GrawHill, New York.

Ram Reddy, S. and Reddy, S.M. (2007). **Essentials of Virology.** Scientific Publishers India, Jodhpur.

Rao, A.S. (1997). **Introduction to Microbiology**. Prentice-Hall of India Pvt Ltd., Nerw Delhi.Black, J.G. (2005).

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Reddy, S.M. and Reddy, S.R. (1998). **Microbiology – Practical Manual**, 3 rd Edition, Sri Padmavathi Publications, Hyderabad.

Singh, R.P. (2007). **General Microbiology**. Kalyani Publishers, New Delhi.

Stanier, R.Y., Adelberg, E.A. and Ingram, J.L. (1991). **General Microbiology**, 5th Ed., Prentice Hall of India Pvt. Ltd., New Delhi.

Sullia, S.B. and Shantaram, S. (1998). **General Microbiology**, Oxford & IBH Publishing Pvt. Ltd., New Delhi.

Talaro, K. and Talaro, A. (1996). **Foundations in Microbiology**. 2nd Edition. UMC Brown Publications.

Webster, J. (1980). **Introduction to Fungi,** Cambridge University Press, Cambridge,

Wilson, K. and Walker, J. (1994). **Practical Biochemistry**. 4 th Edition, Cambridge University Press, England.

Zubay, G. (1998). **Biochemistry** WCB. Mc GrawHill, Iowa.

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

**MADDILAPALEM, VISAKHAPATNAM**

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

**FIRST YEAR –** **SEMESTER- II**

**COURSE-2 MICROBIAL BIOCHEMISTRY & METABOLISM**

**TOTAL HOURS: 60** **CREDITS: 4**

**Course outcomes:** By the end of this course the students

CO 1: Developed a very good understanding of various biomolecules which are required for development and functioning of a bacterial cell.

CO 2: Have developed how the carbohydrates make the structural and functional components such as energy generation and as storage food molecules for the bacterial cells

CO 3: Well conversant about multifarious function of proteins; also knowledge about lipids and nucleic acids.

CO 4: Principles of a number of analytical instruments which the students have to use during the study and also later as microbiologists for performing various laboratory manipulations.

CO 5: Several separation techniques which may be required to be handled later as microbiologists.

CO 6 : Describing the growth characteristics of the microorganisms capable of growing under unusual environmental condition of temperature, oxygen, and solute and water activity.

CO 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.

CO 8 : Differentiating concepts of aerobic and anaerobic respiration and how these are manifested in the form of different metabolic pathways in microorganisms.

CO 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.

CO 10 : Calculate generation time of growing bacteria.

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

Outline classification and general characteristics of carbohydrates (monosaccharides, disaccharides and polysaccharides).

General characteristics of amino acids and proteins.

Structure of nitrogenous bases, nucleotides, nucleic acids.

 Fatty acids (saturated and unsaturated) lipids (sphingolipids, sterols and phospholipids)

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

Principle and applications of - Colorimetry

Chromatography (paper, thin-layer and column),

Spectrophotometry (UV & visible), Centrifugation and Gel Electrophoresis.

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

Properties and classification of Enzymes.

Biocatalysts - induced fit and lock and key models.

Coenzymes and Cofactors.

Factors affecting catalytic activity.

Inhibition of enzyme activity- competitive, noncompetitive, uncompetitive and allosteric.

**UNIT-IV MICROBIAL NUTRITION & GROWTH**  **No. of hours: 12**

Microbial Nutrition –Nutritional requirements and uptake of nutrients by cells.

Nutritional groups of microorganisms- autotrophs, heterotrophs, mixotrophs.

Microbial Growth- different phases of growth in batch cultures, Synchronous, continuous, biphasic growth. Factors influencing microbial growth. Methods for measuring microbial growth – Direct microscopy, viable count estimates, turbidometry and biomass.

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

Aerobic respiration -Glycolysis, HMP path way, ED path way, TCA cycle, Electron transport, oxidative and substrate level phosphorylation. Anaerobic respiration (Nitrate).

Fermentation - Alcohol and lactic acid fermentations.

Outlines of oxygenic and anoxygenic photosynthesis in bacteria.

**Additional inputs:**

Structure of proteins

Pasteur’s effect

Photosynthetic apparatus in green, purple & cyanobacteria

**PRACTICAL - 2 MICROBIAL BIOCHEMISTRY & METABOLISM**

**TOTAL HOURS: 30**  **CREDITS: 1**

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| 1. | Colorimetric estimation DNA by diphenylamine method |
| 2. | Colorimetric estimation of proteins by Biuret/Lowry method |
| 3. | Paper chromatographic separation of amino acids. |
| 4. | Preparation of different media- Synthetic and Complex Media |
| 5. | Setting and observation of Winogradsky column. |
| 6. | Estimation of CFU count by spread plate method/pour plate method. |
| 7. | Bacterial growth curve. |
| 8. | Factors affecting bacterial growth – pH. |
| 9. | Factors affecting bacterial growth – Temperature. |
| 10. | Factors affecting bacterial growth –Salts |

**SUGGESTED READING**

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.

Campbell, PN and Smith AD (2011) **Biochemistry** Illustrated, 4th ed., Published by Churchill Livingstone

Elliot, W.H. and Elliot, D.C. (2001). **Biochemistry and Molecular Biology**, 2 nd Edition, Oxford University Press, U.S.A.

Gottschalk, G. (1986). **Bacterial Metabolism**, SpringerVerlag, NewYork.

Lehninger, A.L., Nelson, D.L. and Cox, M.M. (1993). **Principles of Biochemistry**, 2 nd Edition, CBS Publishers and Distributors, New Delhi.

Madigan, M.T., Martinkl, J.M. and Parker, J. (2010). **Brock Biology of Microorganisms**, 9th Edition, MacMillan Press, England.

Moat, A.G. and Foster, J.W. (1995). **Microbial Physiology**, JohnWiley, New York.

Nelson DL and Cox MM (2008) Lehninger **Principles of Biochemistry**, 5th Edition., W.H. Freeman and Company.

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Sashidhara Rao, B. and Deshpande, V. (2007). **Experimental Biochemistry**: A student Companion. I.K. International Pvt. Ltd.

Stanier, R.Y., Adelberg, E.A. and Ingram, J.L. (1991). **General Microbiology**, 5th Ed.,Prentice Hall of India Pvt. Ltd., New Delhi.

Tymoczko JL, Berg JM and Stryer L (2012) **Biochemistry:** A short course, 2nd ed., W.H.Freeman

Voet,D. and Voet J.G (2004) **Biochemistry** 3rd edition, John Wiley and Sons

White, D. (1995). **The Physiology and Biochemistry of Prokaryotes**, Oxford University Press, New York.

Willey MJ, Sherwood, LM & Woolverton C J (2013) Prescott, Harley and Klein’s **Microbiology** by. 9th Ed., McGrawHill

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**MADDILAPALEM, VISAKHAPATNAM**

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

**SECOND YEAR – SEMESTER- III**

**COURSE - 3 MICROBIAL GENETICS AND MOLECULAR BIOLOGY**

**TOTAL HOURS: 60**  **CREDITS: 4**

**Course outcomes:** By the conclusion of this course, the students have –

CO 1: Understood genome organization of model organisms namely E.coli and Saccharomyces.

CO 2: Developed a fairly good knowledge about the three well known mechanisms by which

 genetic material is transferred among the microorganisms namely transformation,

 transduction and conjugation.

CO 3: Are able to describe different types of the extrachromosomal elements or the plasmids;

 the nature of the transposable elements in the prokaryotic and the eukaryotic cells.

CO 4 : Understood the central dogma – replication, transcription and translation.

CO 5 : Developed knowledge on types of mutations , the molecular mechanisms that underlie

 mutations and their repair.

CO 6 : Understood Genetic code and studied the salient features.

CO 7: Able to explain the Protein synthesis and expression of genes.

CO 8 : Explain the principles and applications of genetic engineering.

CO 9 : Hands on skills of isolation of genomic DNA from bacterial cells and its visualization by

 performing agarose gel electrophoresis.

CO 10 : Are able to explain the working principles of Ultra centrifuge, Transilluminator and

 PCR

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

DNA and RNA as genetic material.

Structure and organization of prokaryotic DNA.

Extrachromosomal genetic elements – Plasmids and transposons.

Replication of DNA – Semi conservative mechanism, Enzymes involved in replication.

**UNIT-II MUTATIONS & RECOMBINATION**  **No. of hours: 12**

Mutations – spontaneous and induced, base pair changes, frame shifts, deletions, inversions, tandem duplications, insertions.

Mutagens - Physical and Chemical mutagens.

Outlines of DNA damage and repair mechanisms.

Genetic recombination in bacteria – Conjugation, Transformation and Transduction.

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

Concept of gene – Muton, Recon and Cistron. One gene one enzyme and one gene one polypeptide hypotheses.

Types of RNA and their functions. Genetic code. Structure of ribosomes.

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

Types of genes – structural, constitutive, regulatory

Protein synthesis – Transcription and translation.

Regulation of gene expression in bacteria – *lac* operon.

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

Basic principles of genetic engineering.

Restriction endonucleases, DNA polymerases and ligases.

Vectors.

Outlines of gene cloning methods.

Polymerase chain reaction. Genomic and cDNA libraries.

General account on application of genetic engineering in industry, agriculture and medicine.

**Additional inputs:**

Forms of DNA

Experiments to prove replication and recombination in bacteria

Inhibitors of transcription & translation

**PRACTICAL-3 MICROBIAL GENETICS AND MOLECULAR BIOLOGY**

**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. Problems related to DNA and RNA characteristics, Transcription and Translation.
6. Induction of mutations in bacteria by UV light.
7. Instrumentation in molecular biology – Ultra centrifuge, Transilluminator, PCR

**SUGGESTED READING**

Crueger, W. and Crueger, A. (2000). **Biotechnology: A Text Book of Industrial Microbiology,** PrenticeHall of India Pvt. Ltd., New Delhi.

Freifelder, D. (1990). **Microbial Genetics**. Narosa Publishing House, New Delhi.

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Glick, B.P. and Pasternack, J. (1998). **Molecular Biotechnology**, ASM Press, Washington D.C., USA.

Kannan, N. (2003). **Hand Book of Laboratory Culture Medias, Reagents, Stains and Buffers**. Panima Publishing Co., New Delhi.

Lewin, B. (2000). **Genes VIII.** Oxford University Press, England

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Ram Reddy, S., Venkateshwarlu, K. and Krishna Reddy, V. (2007) **A text Book of Molecular Biotechnology**. Himalaya Publishers, Hyderabad.

Sinnot E.W., L.C. Dunn and T. Dobzhansky. (1958). **Principles of Genetics**. 5 th Edition. McGraw Hill, New York.

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Snyder, L. and Champness, W. (1997). **Molecular Genetics of Bacteria**. ASM press,

Strickberger, M.W. (1967). **Genetics**. Oxford & IBH, New Delhi.

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.

Twynan, R.M. (2003). **Advanced Molecular Biology**. Viva books Pvt. Ltd. New Delhi.

Verma, P.S. and Agarwal, V.K. (2004). **Cell Biology, Genetics, Molecular Biology, Evolution and Ecology.** S. Chand & Co. Ltd., New Delhi.

Washington, D.C., USA.

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**MADDILAPALEM, VISAKHAPATNAM**

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

**SECOND YEAR – SEMESTER- IV**

**COURSE-4 IMMUNOLOGY AND MEDICAL MICROBIOLOGY**

**TOTAL HOURS: 60** **CREDITS: 4**

**Course outcomes:** By the conclusion of this course, the students clearly –

CO 1 : Conceptualized the protective role of the immune system of the host and developed an understanding of the basic components.

CO 2 : Explain the cells and organs involved in the development of immune response.

CO 3 : Knowledge on antigens, antibodies and their interactions.

CO 4 : Understood the principles and applications of various antigen-antibody reactions.

CO 5 : The mechanisms underlying the immune system and its response to pathogenic microorganisms.

CO 6 : Understood the basic and general concepts of causation of disease by the pathogenic microorganisms and the various parameters of assessment of their severity including the broad categorization of the methods of diagnosis.

CO 7: Has acquired a fairly good understanding of normal microflora of human body, common diseases caused by bacteria, viruses and other microbes.

CO 8: Are able to conduct experiments for growing common bacteria in different microbiological media, antibiotic sensitivity determination and antigen antibody reaction.

CO 9: Identify blood groups , estimate hemoglobin levels and count the WBC.

CO 10: Identify bacteria from clinical samples and analyze antibiotic sensitivity of bacteria.

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

Types of immunity – innate and acquired; active and passive; humoral and cell-mediated immunity.

Primary and secondary organs of immune system – thymus, bursa fabricus, 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 eosinophils.

**UNIT-II ANTIGEN ANTIBODY REACTIONS No. of hours: 12**

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

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

Types of antigen-antibody reactions - Agglutinations, Precipitation, Neutralization, complement fixation, blood groups. Labeled antibody based techniques – ELISA, RIA and Immunofluorescence. Polyclonal and monoclonal antibodies – production and applications.

Concept of hypersensitivity and Autoimmunity.

**UNIT-III HOST MICROBIAL INTERACTIONS & DIAGNOSIS No. of hours: 12**

Normal flora of human body. General account on nosocomial infection.

Host pathogen interactions: infection, invasion, pathogen, pathogenicity, virulence and opportunistic infection.

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 THERAPEUTICS No. of hours: 12**

Antibacterial Agents- Penicillin, Streptomycin and Tetracycline.

Antifungal agents – Amphotericin B, Griseofulvin

Antiviral substances - Amantadine and Acyclovir

Tests for antimicrobial susceptibility.

Brief account on antibiotic resistance in bacteria - Methicillin-resistant Staphylococcus aureus (MRSA).

Vaccines – Natural and recombinant.

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

General account on microbial diseases – causal organism, pathogenesis, epidemiology, diagnosis, prevention and control

Bacterial diseases – Tuberculosis and Typhoid

Fungal diseases – Candidiasis.

Protozoal diseases – Malaria.

Viral Diseases - Hepatitis- A and AIDS

**Additional inputs:**

Primary & secondary immune response

Challenges in development of vaccines

SARS-CoV-2

**PRACTICAL-4 IMMUNOLOGY AND MEDICAL MICROBIOLOGY**

**TOTAL HOURS: 30**  **CREDITS: 1**

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| 1. | 1. Identification of human blood groups.
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| 2. | 1. Separate serum from the blood sample (demonstration).
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| 3. | 1. Estimation of blood haemoglobin.
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| 4. | 1. Total Leukocyte Count of the given blood sample.
 |
| 5. | 1. Differential Leukocyte Count of the given blood sample.
 |
| 6. | 1. 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
 |
| 7. | Isolation of bacterial flora of skin by swab method. |
| 8. | Antibacterial sensitivity by Kirby-Bauer method |

**SUGGESTED READING**

Abbas AK, Lichtman AH, Pillai S. (2007). **Cellular and Molecular Immunology.** 6th edition Saunders Publication, Philadelphia.

Ananthanarayan R. and Paniker C.K.J. (2009) **Textbook of Microbiology**. 8th

edition, University Press Publication

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Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt’s **Essential Immunology**.11th edition Wiley-Blackwell Scientific Publication, Oxford.

Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims’ **Medical**

**Microbiology.** 4th edition. Elsevier

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 Kuby’s **Immunology**. 6th edition W.H. Freeman and Company, New York.

Jawetz, Melnick and Adelberg’s **Medical Microbiology**. 26th edition. McGraw Hill

 Microbiology. 4th edition. Elsevier Publication

Richard C and Geiffrey S. (2009). **Immunology**. 6th edition. Wiley Blackwell Publication.

Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein’s **Microbiology**. 9th edition. McGraw Hill

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**MADDILAPALEM, VISAKHAPATNAM**

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

**FINAL YEAR – SEMESTER- IV**

**COURSE-5 ENVIRONMENTAL & AGRICULTURAL MICROBIOLOGY**

**TOTAL HOURS: 60 CREDITS: 4**

**Course learning outcomes:** By the completion of this course, the students –

CO 1: Have developed a fairly good knowledge and understanding of different types of

 environments and habitats where microorganisms grow including soil, air, water and

 extreme environments.

CO 2: Are able to identify the important role microorganisms play in maintaining healthy

 environment by degradation of solid/liquid wastes; how these activities of microorganisms

 are used in sewage treatment plants, production of activated sludge and functioning of

 septic tanks.

CO 3: Have understood the significance of BOD/COD and various tests involving use of

 enumerating fecal *E.coli* for assessing quality of water.

CO 4: Have developed the practical skills for conducting experiments to assess the BOD/COD of

 wastewaters and their interpretation; practically assess the portability of drinking water by

 the use of standard microbiological tests.

CO 5: Developed a clear understanding of the multifarious roles of microorganisms in soil, in

 association with plants and thus in the field of agriculture.

CO 6: Developed basic concepts of causation of diseases in plants by the different types of

 microorganisms namely bacterial, fungal and viral.

CO 7: Knowledge of important plant diseases, their etiology, salient characteristics and control

 measures.

CO 8: Perform solid waste management and prepare compost with decomposable waste.

CO 9: Understood how the waste water could be converted into reusable water.

CO 10: Concept of biofertilizers and their applications in various fields.

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| **UNIT - I** **MICROBIAL HABITATS No. of hours:12** |
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| Terrestrial Environment: Soil profile and soil microfloraAquatic Environment: Microflora of fresh water and marine habitatsAtmosphere: Aeromicroflora and dispersal of microbesExtreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels. |
|  |
| **UNIT – II** **MICROBIAL INTERACTIONS & WATER MICROBIOLOGY** **No. of hours: 12** |
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| Role of microorganisms in nutrient cycling (Carbon, nitrogen, phosphorus). Microbial interactions – mutualism, commensalism, antagonism, competition, parasitism, predation.\Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive test/MPN test, confirmed and completed tests for faecal coliforms (b) Membrane filter technique. |
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| **UNIT – III** **WASTE MANAGEMENT** **No. of hours: 12** |
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| 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. |
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| **UNIT – IV MICROBES AS FERTILIZERS No. of hours: 12** |
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| Plant Growth Promoting Microorganisms - Mycorrhizae, Rhizobia, *Azospirillum, Azotobacter,* *Frankia,* phosphate-solubilizers and Cyanobacteria*.*Outlines of biological nitrogen fixation (symbiotic, non-symbiotic). Biofertilizers - *Rhizobium*. |
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| **UNIT – V PLANT DISEASES No. of hours: 12** |
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| 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.  |

**Additional inputs:**

Air sampling

Field applications of biofertilizers

**Practical - 5 ENVIRONMENTAL & AGRICULTURAL MICROBIOLOGY**

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| **TOTAL HOURS: 30 CREDITS: 1**1. Analysis of soil – pH, Moisture content and water holding capacity. |
| 2. Isolation of microbes (bacteria and fungi) from soil. |
| 3. Study of air flora by petriplate exposure method.  |
| 4. Analysis of potable water: SPC, Presumptive, confirmed and completed test, determination  of coliform count in water by MPN.  |
| 5. Determination of Biological Oxygen Demand (BOD) of waste water samples. |
| 6. Isolation of *Rhizobium* from root nodules. |
| 7. Staining and observation of Vesicular Arbuscular Mycorrhizal (VAM) fungi. |
| 8. Observation of plant diseases of local importance - Citrus canker, Tikka disease of  Groundnut, Bhendi yellow vein mosaic, Rusts, Smuts, Powdery mildews, Tomato leaf  curl.  |

**SUGGESTED READINGS**

Atlas RM and Bartha R. (2000). **Microbial Ecology: Fundamentals & Applications.** 4th edition. Benjamin/Cummings Science Publishing, USA

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Madigan MT, Martinko JM and Parker J. (2014). **Brock Biology of Microorganisms**. 14th edition. Pearson/ Benjamin Cummings

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Subba Rao NS. (1999). **Soil Microbiology**. 4th edition. Oxford & IBH Publishing Co. New Delhi.

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