



VIKRAMA SIMHAPURI UNIVERSITY:: NELLORE

Common Framework of CBCS for Colleges in Andhra Pradesh

(A.P. State of Council of Higher Education)

B.Sc. Microbiology Core Syllabus under CBCS

(with effect from the Academic Year 2020-21)

Course Structure

Structure of B.Sc. Microbiology Core Syllabus under CBCS

Sem	Paper	Title of Course	Credits	Hrs	Marks		
					Int	Univ	Total
I	I	Introduction to Microbiology and Microbial Diversity	4	4	25	75	100
		Practical –I : Introduction to Microbiology and Microbial Diversity	1	2	--	50	50
II	II	Microbial Physiology and Biochemistry	4	4	25	75	100
		Practical II - Microbial Physiology and Biochemistry	1	2	--	50	50
III	III	Medical Microbiology and Immunology	4	4	25	75	100
		Practical: Medical Microbiology and Immunology	1	2	--	50	50
IV	IV	Microbial Ecology and Industrial Microbiology	4	4	25	75	100
		Practical: Microbial Ecology and Industrial Microbiology	1	2	--	50	50
IV	V	Molecular Biology and Microbial Genetics	4	4	25	75	100
		Practical: Molecular Biology and Microbial Genetics	1	2	--	50	50

B.Sc. Microbiology Syllabus

(Choice-Based Credit System - W.E.F. 2020-21)

SEMESTER I

MBT- I: INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY

TOTAL HOURS: 48

CREDITS: 4

UNIT-I: History of Microbiology and place of Microorganisms in living world 10 Hrs

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

Classification of microorganisms. Haeckel's three kingdom; Whittaker's five kingdom concept; Carl Woese three domain concept; Bergey's Manual of Systematic Bacteriology.

UNIT-II: Prokaryotes, Eukaryotes and Virus Structure Morphology and General Characters 10 Hrs

Ultrastructure of Prokaryotic cell - Variant components and invariant components. Cell wall of bacteria Gram positive cell wall, Gram negative cell wall, Cell wall of fungi, General characteristics and of Bacteria, Archaea, Actinomycetes, Mycoplasmas, Spirochetes, Rickettsiae, Cyanobacteria, Fungi, Algae, Protozoa, General characters of virus Morphology structure, replication of TMV and Lambda phage.

UNIT-III: Staining , Microscopy, Sterilization and Disinfection 10 hrs

Staining Techniques - Simple and Differential staining techniques (Gram-staining, Zeil-Nelson staining for AFB). Spore staining, flagellar staining, Hanging-Drop for bacterial Motility. Principles of microscopy - Bright field and Electron microscopy (SEM and TEM), Principle of micrometer Methods of sterilization: Physical methods – Dry heat, moist heat, radiation methods, filtration, Chemical methods and their application.

UNIT-IV: Isolation and cultivation of Microorganisms**No. of hours: 10**

Isolation of microorganisms from natural habitat. Microbiological media-Natural, synthetic, basal, defined, complex, enrichment, selective, differential, maintenance and transport media.

Microbial cultures: Concept of pure culture, Methods of pure culture isolation, Enrichment culturing techniques.

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

UNIT-V: Microbial growth**No. of hours: 10**

Microbial growth: Kinetics of growth (Bacterial Growth curve), Methods of measuring growth: Direct methods: viable plate counts, membrane filtration. Indirect methods: Metabolic activity – measurements of DNA, Protein, Microscopic counts, electronic counters, Cultivation and Enumeration of viruses.

MBP- I: 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-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:

- Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. (1993). Microbiology. 5th Edition, Tata Mc

Graw Hill Publishing Co., Ltd., New Delhi.

- Dube, R.C. and Maheswari, D.K. (2000) General Microbiology. S Chand, New Delhi. Edition), Himalaya Publishing House, Mumbai.
- Power, C.B. and Dagainawala, H.F. (1986). General Microbiology Vol I & II
- Prescott, M.J., Harley, J.P. and Klein, D.A. (2010). Microbiology. 5th Edition, WCB Mc GrawHill, New York.
- 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.
- Microbiology Edited by Prescott
- Jaya Babu (2006). Practical Manual on Microbial Metabolisms and General Microbiology. Kalyani Publishers, New Delhi.
- Gopal Reddy *et al.*, Laboratory Experiments in Microbiology

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SEMESTER II

MBT- II: MICROBIAL PHYSIOLOGY AND BIOCHEMISTRY

TOTAL HOURS: 48

CREDITS: 4

UNIT-I: Carbohydrates, Lipids, Amino acids and Proteins

8 Hrs

Carbohydrates – Classification, chemistry, properties, and function– mono, di, oligo and polysaccharides. Lipids – classification, chemistry, properties and function – free fatty acids, triglycerides, phospholipids, glycolipids & waxes

General characters of amino acids and proteins (Structural levels Primary, Secondary, Tertiary and Quaternary)

UNIT – II: Nucleic acid

10 hrs

Nucleic acids – structure, function and their properties. Structural polymorphism of DNA, RNA. Chemical structure and base composition of nucleic acids, Chargaff's rules, Watson-Crick Model (B-DNA), deviations from Watson- Crick model, other forms of DNA (A- and Z-DNA), forces stabilizing nucleic acid structures, (hydrogen bonds and hydro phobic associations, bases tacking). Structural characteristics of RNA. Types of RNA.

UNIT-III: Microbial Nutrition

10 hrs

Nutritional requirements of microorganisms, Methods of uptake of nutrients by cell, Nutritional Groups of Microorganisms, Batch and continuous growth, Synchronous culture, Diauxic growth. Cultivation of aerobes and anaerobes. Factors effecting Microbial Growth, Physiology of spore formation.

UNIT – IV: Microbial Metabolism**10 hrs**

Aerobic respiration - Glycolysis, HMP path way, ED path way, TCA cycle, Electron transport, oxidative and substrate level phosphorylation. Glyoxylate cycle, Gluconeogenesis, Anaplerotic reaction.

Anaerobic respiration:- Fermentation Biochemical mechanisms of lactic acid, and ethanol,

Nitrate and sulphate respiration. Oxygenic and Anoxygenic photosynthesis in bacteria.

UNIT-V: Enzymes & Analytical Techniques**10 hrs**

Properties and classification of Enzymes. Biocatalysis - induced fit and lock and key models. Coenzymes and Co-factors. Factors affecting catalytic activity.

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

Principle and applications of Colorimetry, Spectrophotometry (UV and Visible)

Chromatography,

MBP – II: MICROBIAL PHYSIOLOGY AND BIOCHEMISTRY**TOTAL HOURS: 48****CREDITS: 2**

1. Qualitative Analysis of Carbohydrates.
2. Qualitative Analysis of Amino acids.
3. Colorimetric estimation DNA by diphenylamine method.
4. Estimation of RNA by Orcinol method.
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. Effect of temperature/pH on enzyme activity
11. Demonstration of immobilization of enzyme activity.

SUGGESTED READING:

- Lehninger, A.L., Nelson, D.L. and Cox, M.M. (1993). Principles of Biochemistry, 2nd Edition, CBS Publishers and Distributors, New Delhi.
- Sashidhara Rao, B. and Deshpande, V. (2007). Experimental Biochemistry: A student Companion. I.K. International Pvt. Ltd.
- 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.

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SEMESTER III

MBT- III: MEDICAL MICROBIOLOGY AND IMMUNOLOGY

TOTAL HOURS: 48

CREDITS: 4

UNIT- I: Immune System

No. of hours: 10

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.

Primary immune response and secondary immune response.

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

Phagocytosis, Complement pathway- classical pathway.

UNIT –II: Immune Response

No. of hours: 10

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,

Labeled antibody based techniques - ELISA, RIA and Immuno fluorescence.

Polyclonal and monoclonal antibodies –production and applications.

Concept of Hypersensitivity and Autoimmunity.

UNIT- III: Microbes in health and disease

No. of hours: 8

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 of clinical samples. General methods of laboratory diagnosis - cultural, biochemical, serological and molecular methods.

UNIT- IV: Microbial disease and Diagnosis

10 hrs

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

Bacterial diseases –Tuberculosis, Typhoid, *Staphylococcus aureus*, *Clostridium Tetani*

Fungal diseases – Candidiasis, Aspergillosis,

Protozoal diseases – Malaria,

Viral Diseases – Hepatitis – A & C and AIDS. Corona virus, Dengue virus.

UNIT- V: Prevention and Treatment

No. of hours: 10

Principles of chemotherapy, Antibacterial drugs – Penicillin, Antifungal drugs – Amphotericin and Griseofulvin; Antiviral agents – Amantadine, Acyclovir,

Drug resistance in bacteria; Test for antimicrobial susceptibility, Factors effecting antimicrobial drug effectiveness; Vaccines and its types; Interferon–Nomenclature, types & classification.

MBP – III: MEDICAL MICROBIOLOGY AND IMMUNOLOGY

TOTAL HOURS: 48

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. Immuno diffusion 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:

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

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SEMESTER IV

MBT- IV: MICROBIAL ECOLOGY AND INDUSTRIAL MICROBIOLOGY

TOTAL HOURS: 60

CREDITS: 4

UNIT – I: Microbial Ecology

No. of hours: 12

Role of microorganisms in Biogeochemical cycles (Carbon, nitrogen, phosphorus)

Microbe-microbe interactions –Synergism, mutualism, commensalism, antagonism, competition, parasitism, predation

Plant- Microbe interactions – Plant growth promoting Microorganisms, Plant pathogens

Extremophilic microorganisms

UNIT – II: Microorganisms in Environment

No. of hours: 12

Microbes in waste management- solid and liquid waste (aerobic and anaerobic)

Microbes in degradation of Xenobiotics

Microbes in drinking water- detection of potability by (a) standard qualitative procedure: presumptive test/MPN test, confirmed and completed tests for fecal coliforms (b) Membrane filter technique

Microbes in food –intrinsic and extrinsic parameters that affect microbial growth in food

UNIT – III: Industrial Microbiology

No. of hours: 12

Microorganisms of industrial importance – yeasts, moulds, bacteria, actinomycetes.

Industrially important Primary and secondary microbial metabolites –

Screening techniques involved in selection of industrially important metabolites from microbes.

Strain improvement

UNIT – IV: Fermentation processes

No. of hours: 12

Design of fermenter (for control of pH, temperature, dissolved oxygen, foaming and aeration)

Types of fermenter – batch, continuous and fed batch.

Types of fermentation processes – solid state, liquid state, batch, fed-batch and continuous.

Fermentation media (Crude and synthetic media; molasses, corn- steep liquor, sulphite waste liquor, whey, yeast extract and protein hydrolysates)

Downstream processing - filtration, centrifugation, cell disruption, solvent extraction.

UNIT – V: Microbial Productions

No. of hours: 12

Microbial production of Industrial products: Citric acid, Ethanol production and yield estimation, Penicillin, Glutamic acid, vitamin B12, Amylase, Yogurt

Microbial cells as food- SCP

MBP – IV: MICROBIAL ECOLOGY AND INDUSTRIAL MICROBIOLOGY

Total hours: 36

Credits: 2

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

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SEMESTER IV

MBT- V: MOLECULAR BIOLOGY AND MICROBIAL GENETICS

TOTAL HOURS: 60

CREDITS: 4

UNIT- I: Nucleic acids

No. of hours: 12

DNA and RNA – Role in heredity-The central dogma

Types of RNA, structure and functions

Organization of DNA in prokaryotes

Extra chromosomal genetic elements - Plasmids and transposons

UNIT- II :Genetic material and replication

No. of hours: 12

Experiments which established DNA as genetic material

Mechanism of DNA Replication in Prokaryotes

Proof of semi conservative mechanism of replication (Messelson - Stahl Experiment)

UNIT- III: Gene expression and regulation

No. of hours: 12

Concept of gene - One gene- one polypeptide, one gene- one enzyme and one gene-one product hypothesis. Modern concept of Gene -Muton, recon and cistron;

Genetic code

Structure of ribosomes

Protein synthesis – Transcription and translation in Prokaryotes

Regulation of gene expression in bacteria – *lac* operon

UNIT- IV: Mutations, damage and repair

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

Bacterial recombination – Transformation, Conjugation, Transduction (Generalized and specialized transductions)

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.

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MBP – V: MOLECULAR BIOLOGY AND MICROBIAL GENETICS

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*
Isolation of plasmid DNA
4. Estimation of DNA using UV spectrophotometer.
5. Resolution and visualization of DNA by Agarose Gel Electrophoresis.
6. Resolution and visualization of proteins by Polyacrylamide Gel Electrophoresis (SDS - PAGE).
7. Problems related to DNA and RNA characteristics, Transcription and Translation.
8. Induction of mutations in bacteria by UV light.
9. Instrumentation in molecular biology - Transilluminator,

SUGGESTED READING:

- Freifelder, D. (1990). Microbial Genetics. Narosa Publishing House, New Delhi.
- Freifelder, D. (1997). Essentials of Molecular Biology. Narosa Publishing House, New Delhi.
- Glick, B.P. and Pasternack, J. (1998). Molecular Biotechnology, ASM Press, Washington D.C., USA.
- Lewin, B. (2000). Genes VIII. Oxford University Press, England.
- Maloy, S.R., Cronan, J.E. and Freifelder, D. (1994). Microbial Genetics, Jones and Bartlett Publishers, London.
- Ram Reddy, S., Venkateswarlu, 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.
- Smith, J.E. (1996). Biotechnology, Cambridge University Press.
- Snyder, L. and Champness, W. (1997). Molecular Genetics of Bacteria. ASM press,
- Strickberger, M.W. (1967). Genetics. Oxford & IBH, New Delhi.
- Verma, P.S. and Agarwal, V.K. (2004). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Co. Ltd., New Delhi.