

AP STATE COUNCIL OF HIGHER EDUCATION

CBCS PATTERN FOR MICROBIOLOGY

B.Sc MICROBIOLOGY (CBCS) REVISED SYLLABUS - 2020

YEAR	SEMESTER	PAPER	TITLE	MARKS	CREDITS
I	I	MBT - I	INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY	100	4
		MBP I	INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY	50	1
	II	MBT II	MICROBIAL PHYSIOLOGY AND BIOCHEMISTRY	100	4
		MBP II	MICROBIAL PHYSIOLOGY AND BIOCHEMISTRY	50	1
II	III	MBT III	MOLECULAR BIOLOGY AND MICROBIAL GENETICS	100	4
		MBP III	MOLECULAR BIOLOGY AND MICROBIAL GENETICS	50	1
	IV	MBT - IV	IMMUNOLOGY AND MEDICAL MICROBIOLOGY	100	4
		MBP IV	IMMUNOLOGY AND MEDICAL MICROBIOLOGY	50	1
		MBT - V	MICROBIAL ECOLOGY AND INDUSTRIAL MICROBIOLOGY	100	4
		MBP - V	MICROBIAL ECOLOGY AND INDUSTRIAL MICROBIOLOGY	50	1

C. Mohan
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Pallavi
16/11/21

B.Sc MICROBIOLOGY (CBCS) REVISED SYLLABUS - 2020

MBT- I: INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY

TOTAL HOURS: 60

CREDITS: 4

UNIT-I: History of Microbiology & Place of Microorganisms in the living world

No. of hours: 12

History of Microbiology- Theory of spontaneous generation-Biogenesis and abiogenesis; in the context of contributions of Anton von Leeuwenhoek, Edward Jenner, Louis Pasteur, Robert Koch, Ivanowsky, Martinus Beijerinck and Sergei Winogradsky

Importance and applications of microbiology

Place of Microorganisms in the Living World Haeckel s three Kingdom concept, Whittaker s five kingdom concept, three domain concept of Carl Woese

UNIT-II: Prokaryotic microorganisms and Viruses

No. of hours: 12

Ultra structure of Prokaryotic cell- cell wall (in detail); Structure and/Functions (in brief) of cell membrane, cytoplasm, nucleoid, plasmid, inclusion bodies, flagella (brief structure and arrangement), pili, capsule, endospore

General characteristics of Bacteria (Size, shape, arrangement, reproduction); few examples of heterotrophic, autotrophic, parasitic, obligate intracellular parasitic bacteria.

General characteristics of Archaea

General characteristics of viruses, Cultivation of Viruses (in brief)

Morphology, Structure and replication of TMV and Lambda

UNIT-III: Eukaryotic microorganisms

No. of hours: 12

Fungi - Habitat, nutrition, vegetative structure and modes of reproduction; outline classification

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

Protozoa – Habitat, cell structure, nutrition, locomotion, excretion, reproduction, encystment, outline classification

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UNIT-IV: Principles of Microscopy, Sterilization and Disinfection **No. of hours: 12**

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

Staining Techniques - Simple and Differential staining techniques (Gram staining, spore staining, Acid fast 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 and Culture of Bacteria and Fungi

No. of hours: 12

Isolation of Microorganisms from natural habitats.

Growth media- Natural, synthetic and semi synthetic media, Basal and complex media, selective, enrichment, enriched and differential media

Pure culture techniques dilution-planting, Streak-plate, Spread-plate, Pour-Plate and micromanipulator. Preservation of microbial cultures sub culturing, overlaying cultures with mineral oils, lyophilization, sand cultures, storage at low temperature.

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16/11/21*

MBP- I: INTRODUCTION TO 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. Microscopic observation of bacteria (Gram +ve bacilli and cocci, Gram -ve bacilli), Algae and Fungi.
8. Simple staining
9. Gram s staining
10. Hanging-drop method.
11. Isolation of pure cultures of bacteria by serial dilution and streak/spread/pour plate method.
12. Preservation of bacterial cultures by various techniques.
13. Observation of electron micrographs of bacterial cells

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Pallan
16/1/21

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 Daginawala, H.F. (1986). General Microbiology Vol I & II
- Prescott, M.J., Harley, J.P. and Klein, D.A. (2012). 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

Chandhi
Raj

Pallan
16/1/21

TOTAL HOURS: 60

CREDITS: 4

UNIT-I: Biomolecules

No. of hours: 12

General characters and outline classification of Carbohydrates (Monosaccharides-Glucose, fructose, ribose, Disaccharides- Sucrose, Lactose, Polysaccharides- Starch, glycogen, Cellulose)
General characters and outline classification of Lipids and fatty acids (phospholipids, polybeta hydroxy alkanes)
General characteristics of amino acids and proteins. Amino acids in peptidoglycan
Structure of Nucleic acid

UNIT-II: Enzymes

No. of hours: 12

Properties and classification of Enzymes.
Biocatalysis - induced fit and lock and key models.
Coenzymes and Cofactors.
Inhibition of enzyme activity- competitive, noncompetitive, uncompetitive and allosteric.
Factors effecting enzyme activity

UNIT III: Analytical Techniques

No. of hours: 12

Principle and applications of -
Colorimetry
Chromatography (paper, thin-layer and column),
Spectrophotometry (UV & visible),
Centrifugation and
Gel Electrophoresis (Agarose and SDS).

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16/1/21

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UNIT IV: Microbial Nutrition and growth

No. of hours: 12

Nutritional requirements of Microorganisms

Methods of uptake of nutrients by cells

Nutritional groups of microorganisms- autotrophs, heterotrophs, lithotrophs, organotrophs, phototrophs, chemotrophs

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, TCA cycle, ED Pathway, Electron transport

Oxidative and substrate level phosphorylations.

Anaerobic respiration (Nitrate and sulphate respiration)

Fermentation- lactic acid and ethanol fermentations

Outlines of oxygenic and anoxygenic photosynthesis in bacteria

Chandhi

Pray

Pallan
16/1/21

TOTAL HOURS: 30

CREDITS: 1

1. Qualitative Analysis of Carbohydrates.
2. Qualitative Analysis of Aminoacids.
3. Colorimetric estimation of proteins by Biuret / Lowry method.
4. Separation of components of a given mixture using a laboratory scale centrifuge.
5. Separation of mixtures by paper / thin layer chromatography.
6. Demonstration of column packing in any form of column chromatography.
7. Effect of temperature / pH on bacterial growth
8. Demonstration of electrophoretic technique
9. Study and plot the growth curve of E. coli by turbidometric and standard plate count methods

C. Mohi

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Pallan
16/1/21

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.
- Lehninger, A.L., Nelson, D.L. and Cox, M.M. (1993). Principles of Biochemistry, 2 nd
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.

C. Mohi
Group

Pallan
16/1/2

MBT III: 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
Watson and Crick model of DNA
Types of RNA, structure and functions
Organization of DNA in prokaryotes

UNIT- II : Genetic material and replication

No. of hours: 12

Experiments which established DNA as genetic material
RNA as genetic material
Mechanism of DNA Replication in Prokaryotes
Proof of semi conservative mechanism of replication (Messelson - Stahl Experiment)
Extra chromosomal genetic elements - Plasmids and transposons

UNIT- III: Gene expression and regulation

No. of hours: 12

Concept of gene - Mutton, recon and cistron; One gene- one polypeptide, one gene- one enzyme and one gene-one product hypothesis.
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

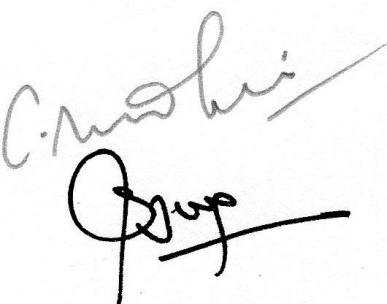
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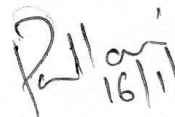
Outlines of DNA damage and repair mechanisms
Mutations - spontaneous and induced, base pair changes, frame shifts, deletions, inversions, tandem duplications, insertions
Mutagens - Physical and Chemical mutagens
Bacterial recombination Transformation, Conjugation, Transduction (Generalized and specialized 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.





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. 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 - Ultra centrifuge, Transilluminator, PCR

C. Mohi
P. Singh

P. Mallari
16/1/2

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., 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.
- 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.

Mohi
Prasanna

Prasanna
16/1/21

TOTAL HOURS: 60

CREDITS: 4

UNIT-I: Immune System

No. of hours: 12

Concept of Innate and Adaptive immunity

Primary and secondary organs of immune system thymus, bursa fabricus, bone marrow, spleen, lymph nodes and lymphoid tissues

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

Complement system (in brief)

UNIT-II : Immune response

No. of hours: 12

Characteristics of antigen (Foreignness, Molecular size, Heterogeneity and solubility) haptens.

Antibodies basic structure and types.

Generation of Immune Response - Primary and Secondary Immune Response

MHC- Functions of MHC I & II molecules

Generation of Humoral Immune Response (Plasma and Memory cells), Immune complex formation and elimination - Agglutination, Precipitation, Neutralisation, Complement fixation, Phagocytosis

Generation of Cell Mediated Immune Response

Hypersensitivity- definition and types (in brief)

UNIT- III: Microbes in Health and Disease

No. of hours: 12

Normal flora of human body.

Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Opportunistic infections, Nosocomial infections.

General account on microbial diseases causal organism, pathogenesis, epidemiology, diagnosis, prevention and control of the following

Bacterial diseases Tuberculosis, Typhoid, Botulism

Fungal diseases Candidiasis.

Protozoal diseases Malaria.

Viral Diseases - Hepatitis- A and AIDS

Pallan
16/11/20

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UNIT- IV: Principles of Diagnosis

No. of hours: 12

General principles of diagnostic microbiology- Collection, transport of clinical samples
Identification by culturing
Identification by biochemical/physiological properties
Identification by molecular assays (PCR, DNA probes)
Identification by serological tests (ELISA, Immunofluorescence, Agglutination based tests, Complement fixation)

UNIT- V: Prevention and Treatment

No. of hours: 12

Vaccines Active (Natural and recombinant) and passive
Monoclonal antibodies- Production and application
Antimicrobial agents- General modes of action of antibacterial (Penicillin, Streptomycin), antifungal (Amphotericin and Griseofulvin), antiviral (Amantadine, Acyclovir) agents
Interferons
Tests for antimicrobial susceptibility (Disc diffusion)
Antibiotic resistance in bacteria

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Pallavi
16/1/21

1. Identification of human blood groups.
2. Separate serum from the blood sample (demonstration).
3. Immunodiffusion by Ouchterlony method.
4. Identification of any of the bacteria (*E. coli*, *Pseudomonas*, *Staphylococcus*, *Bacillus*) using laboratory strains on the basis of cultural, morphological and biochemical characteristics: IMViC, urease production and catalase tests
5. Study of composition and use of important differential media for identification of bacteria: EMB Agar, McConkey agar, Mannitol salt agar, Deoxycholate citrate agar, TCBS Isolation of bacterial flora of skin by swab method.
6. Antibacterial sensitivity by Kirby-Bauer method
7. Determination of minimal inhibitory concentration of an antibiotic
8. Study symptoms of the diseases with the help of photographs: Anthrax, Polio, Herpes, chicken pox, HPV warts, Dermatomycoses (ring worms)
9. Study of various stages of malarial parasite in RBCs using permanent mounts.

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16/1/21

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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MBT V: MICROBIAL ECOLOGY AND INDUSTRIAL MICROBIOLOGY

TOTAL HOURS: 60

CREDITS: 4

UNIT I: Microorganisms in environment

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 Food and Water

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 faecal coliforms (b) Membrane filter technique, Microbes in food intrinsic and extrinsic parameters that affect microbial growth in food

UNIT III: Industrial Microbiology

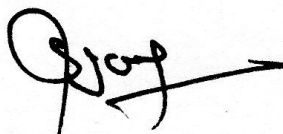
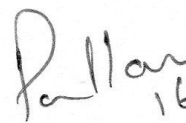
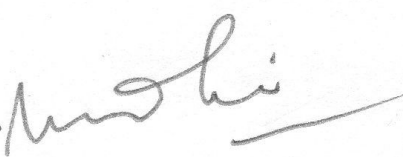
No. of hours: 12

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

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, 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.



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

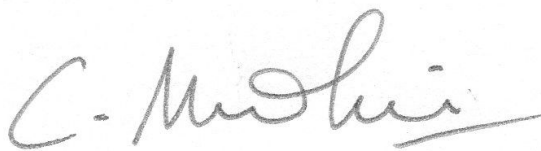
Microbial cells as food- SCP

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Pallavi
16/1/21

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

The syllabus, Pg. No. 1 to 19 of this document is approved w.e.f the current academic year 2020-21 for the students admitted from academic year 2020-21 onwards.



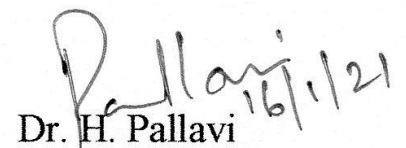
Dr. C. Madhavi

Member, BOS

Lecturer in Microbiology

Govt. College, Autonomous

Anantapuramu



Dr. H. Pallavi

Chairperson, BOS

Lecturer in Microbiology

Govt. College, Autonomous

Anantapuramu



Dr. Sai Ramalinga Reddy

Assistant professor

Department of Microbiology

SSBN Degree & P.G College, Autonomous

Anantapuramu

Recommended Format for Question Paper

MICROBIOLOGY

Time: 2 1/2 Hours

[Max. Marks :75]

Section-A

[5X5=25]

Answer any FIVE of the following questions.

- 1 Contents of **Unit-I**
- 2 Contents of **Unit-II**
- 3 Contents of **Unit-III**
- 4 Contents of **Unit-IV**
- 5 Contents of **Unit-V**
- 6 Contents of **Unit-I to Unit V**
- 7 Contents of **Unit-I to Unit V**
- 8 Contents of **Unit-I to Unit V**

Section-B

[5X10=50]

Answer FIVE questions

9 a Contents of **Unit-I**

(OR)

9 b Contents of **Unit-I**

10 a Contents of **Unit-II**

(OR)

10 b Contents of **Unit-II**

11 a Contents of **Unit-III**

(OR)

11 b Contents of **Unit-III**

12 a Contents of **Unit-IV**

(OR)

12 b Contents of **Unit-IV**

13 a Contents of **Unit-V**

(OR)

13 b Contents of **Unit-V**

Madhu

Q. Singh

Pallavi
16/1/21