

## CBCS PATTERN FOR MICROBIOLOGY

### B.Sc MICROBIOLOGY (CBCS) REVISED SYLLABUS – 2020-21

YEAR	SEMESTER	PAPER	TITLE	MARKS	CREDITS	
<b>I</b>	<b>I</b>	MBT - I	INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY	100		
		MBP – I	INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY	50		
	<b>II</b>	MBT – II	MICROBIAL PHYSIOLOGY AND BIOCHEMISTRY	100		
		MBP – II	MICROBIAL PHYSIOLOGY AND BIOCHEMISTRY	50		
<b>II</b>	<b>III</b>	MBT –III	MEDICAL MICROBIOLOGY AND IMMUNOLOGY	100		
		MBP – III	MEDICAL MICROBIOLOGY AND IMMUNOLOGY	50		
		MBT - IV	INDUSTRIAL MICROBIOLOGY	100		
		MBP – IV	INDUSTRIAL MICROBIOLOGY	50		
	<b>IV</b>	MBT - V	MOLECULAR BIOLOGY AND MICROBIAL GENETICS	100		
		MBP - V	MOLECULAR BIOLOGY AND MICROBIAL GENETICS	50		
<b>III</b>	<b>V</b>	<b>A – PAIR</b>				
		MBT – A1	FOOD, AGRICULTURE AND ENVIRONMENTAL MICROBIOLOGY	100		
		MBP – A1	FOOD, AGRICULTURE AND ENVIRONMENTAL MICROBIOLOGY	50		
		MBT – A2	MANAGEMENT OF HUMAN MICROBIAL DISEASES AND DIAGNOSIS	100		

		MBP – A2	MANAGEMENT OF HUMAN MICROBIAL DISEASES AND DIAGNOSIS	50	
		<b>B – PAIR</b>			
		MBT – B1	MICROBIAL BIOTECHNOLOGY AND r – DNA TECHNOLOGY	100	
		MBP – B1	MICROBIAL BIOTECHNOLOGY AND r – DNA TECHNOLOGY	50	
		MBT – B2	BIostatISTICS AND BIOINFORMATICS	100	
		MBP – B2	BIostatISTICS AND BIOINFORMATICS	50	
		<b>C – PAIR</b>			
		MBT – C1	MICROBIAL QUALITY CONTROL INSTRUMENTATION AND TECHNIQUES	100	
		MBP – C1	MICROBIAL QUALITY CONTROL INSTRUMENTATION AND TECHNIQUES	50	
		MBT – C2	DRUG DESIGN, DISCOVERY AND ITELECTUAL PROPERTY RIGHTS (IPR)	100	
		MBP – C2	DRUG DESIGN, DISCOVERY AND ITELECTUAL PROPERTY RIGHTS (IPR)	50	

# **CBCS PATTERN FOR MICROBIOLOGY**

## **B.Sc MICROBIOLOGY (CBCS) REVISED SYLLABUS – 2020-21**

### **MBT- I: INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY**

**TOTAL HOURS: 48**

**CREDITS: 4**

#### **UNIT-I:**

**No. of hours: 10**

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. Whittaker's five kingdom concept, Bergey's Manual of Systematic Bacteriology. General characteristics and outline classification of Bacteria, Archaea, Mycoplasmas, Cyanobacteria, Fungi, Algae, Protozoa and viruses.

#### **UNIT-II:**

**No. of hours: 10**

Methods of sterilization: Physical methods – Dry heat, moist heat, radiation methods, filtration methods, Chemical methods and their application.

Microbial cultures: Concept of pure culture, Methods of pure culture isolation, Enrichment culturing techniques, single cell isolation, and pure culture development.

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

#### **UNIT-III:**

**No. of hours: 8**

Staining Techniques - Simple and Differential staining techniques.

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

Nutritional types of bacteria. Microbiological media-Natural and synthetic basal, defined, complex, enrichment, selective, differential, maintenance and transport media.

**UNIT-IV:****No. of hours: 10**

Microbial growth: Principles of growth, Kinetics of growth, Methods of measuring growth: Direct methods: viable plate counts, membrane filtration. Indirect methods: Metabolic activity – measurements of DNA, Protein, Microscopic counts, electronic counters, most probable number; Batch and continuous growth, Synchronous culture, Diauxic growth, Types of cultures-stock, batch, continuous and synchronous cultures. Cultivation of aerobes and anaerobes. Reproduction in bacteria and spore formation.

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

Ultra structure of Prokaryotic cell- Variant components and invariant components. Cell wall of bacteria and fungi, Gram positive cell wall, Gram negative cell wall, Cell wall of fungi and yeasts. Morphology, Ultrastructure and chemical composition of bacteria, Actinomycetes, Spirochetes, Rickettsiae, Mycoplasma, Chlamydiae. Economic importance of algae and fungi. SCP.

**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'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:**

- 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

**B.Sc MICROBIOLOGY (CBCS) REVISED SYLLABUS – 2020-21**

**MBT – II: MICROBIAL PHYSIOLOGY AND BIOCHEMISTRY**

**TOTAL HOURS: 48**

**CREDITS: 4**

**UNIT-I:**

**No. of hours: 8**

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

**UNIT-II:**

**No. of hours: 10**

Amino acids – classification, structure and function. Essential amino acids & amphoteric nature of amino acids and reactions and functions of carboxyl and amino groups and side chains. Proteins– isolation and characterization of proteins. Structural levels of proteins– primary, secondary, tertiary and quaternary, denaturation of proteins. Hydrolysis of proteins. Outlines of Protein sequencing using various methods.

**UNIT – III:**

**No. of hours: 10**

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 hydrophobic associations, base stacking). Structural characteristics of RNA. Types of RNA.

**UNIT – IV:**

**No. of hours: 10**

Aerobic respiration - Glycolysis, HMP path way, ED path way, TCA cycle, Electron transport, oxidative and substrate level phosphorylation. Krebs' cycle, glyoxylate cycle, hexose monophosphate (HMP) shunt, gluconeogenesis.

Anaerobic respiration Fermentation, Biochemical mechanisms of lactic acid, ethanol, butanol and citric acid fermentations. Nitrate and sulphate respiration. Outlines of oxygenic and anoxygenic photosynthesis in bacteria.

**UNIT- V**

**No. of hours: 10**

Properties and classification of Enzymes. Biocatalysis- induced fit and lock and key models.

Coenzymes and Cofactors. Factors affecting catalytic activity.

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

Enzyme kinetics: Michaelis-Menten equation, effect of substrate concentration, effect of enzyme concentration, effect of pH and temperature, temperature.

## **MBP – II: MICROBIAL PHYSIOLOGY AND BIOCHEMISTRY**

**TOTAL HOURS: 48**

**CREDITS: 2**

1. Qualitative Analysis of Carbohydrates.
2. Qualitative Analysis of Aminoacids.
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:**

- 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.

**B.Sc MICROBIOLOGY (CBCS) REVISED SYLLABUS – 2020-21**  
**MBT – III: MEDICAL MICROBIOLOGY AND IMMUNOLOGY**

**TOTAL HOURS: 48**

**CREDITS: 4**

**UNIT- I:**

**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- II:**

**No. of hours: 10**

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

Bacterial diseases - Tuberculosis and Typhoid

Fungal diseases – Candidiasis, Aspergillosis, Yeast

Protozoal diseases – Malaria, Filaria & Diseases spread by House Fly.

Viral Diseases - Hepatitis- A & C and AIDS.

**UNIT- III:**

**No. of hours: 10**

Description and pathology of diseases caused by Aspergillus, Penicillium. Description and pathology of diseases caused by hemoflagellates; *Leishmania donovani*, *L.tropica*,



*Trypanosoma gambiense*. Principles of chemotherapy, Antibacterial drugs – Penicillin, Antifungal drugs – Nystatin, Antiviral agents – Ribavirin, Drug resistance in bacteria. Interferon – Nomenclature, types & classification, Induction of interferon, types of Inducers.

**UNIT- IV:**

**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.

Cells of immune system.

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

**UNIT – V:**

**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, blood groups.

Labeled antibody based techniques - ELISA, RIA and Immuno fluorescence. Polyclonal and monoclonal antibodies - production and applications.

Concept of Hypersensitivity and Autoimmunity. Hybridoma technology.

**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. 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:**

- 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.

## **B.Sc MICROBIOLOGY (CBCS) REVISED SYLLABUS – 2020-21**

### **MBT – IV INDUSTRIAL MICROBIOLOGY**

#### **UNIT – I**

**No. of hours: 7**

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

#### **UNIT – II**

**No.of hours: 10**

Fermentation and fermenter: concept and discovery of fermentation. Fermenter: its parts and function. Types of fermenter – batch, continuous and fed batch.

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

Basic concepts of Design of fermenter.

Ingredients of Fermentation media.

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

#### **UNIT – III**

**No.of hours: 8**

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

#### **UNIT – IV**

**No.of hours: 7**

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

#### **UNIT – V**

**No.of hours:7**

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

## **MBP – IV 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

### **B.Sc MICROBIOLOGY (CBCS) REVISED SYLLABUS - 2020**

## **MBT – V: MOLECULAR BIOLOGY AND MICROBIAL GENETICS**

**TOTAL HOURS: 48**

**CREDITS: 4**

### **UNIT- I**

**No. of hours: 8**

DNA and RNA as genetic material. Structure and organization of prokaryotic DNA. Watson and Crick model of DNA. Extra chromosomal genetic elements - Plasmids and transposons. Replication of DNA - Semi conservative mechanism, Enzymes involved in replication.

### **UNIT- II**

**No. of hours: 10**

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**

**No. of hours: 10**

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.

Bacterial recombination – Bacterial transformation, Bacterial conjugation, Transduction–

Generalized and specialized transductions.

### **UNIT- IV**

**No. of hours: 8**

Types of genes - structural, constitutive, regulatory, clustered genes and the control of gene expression. Regulation of gene expression in bacteria - operon concepts - Negative and positive control of the Lac Operon, trp operon. Poly and Mono cistronic m-RNA.

### **UNIT- V**

**No. of hours: 10**

**Transcription:** Enzymatic Synthesis of RNA - Basic features of RNA synthesis, *E.coli* RNA polymerase, Classes of RNA molecules, processing of tRNA and rRNA in *E.coli*, Transcription in Eukaryotes, Eukaryotic rRNA genes, formation of eukaryotic tRNA molecules, RNA Polymerases of eukaryotes. **Translation:** Outline of Translation, The Genetic Code, The Decoding System, Codon Anticodon interaction. Protein Synthesis, Complex Translation units, Inhibitors and Modifiers of protein synthesis, Protein Synthesis in Eukaryotes.

## **MBP – V: MOLECULAR BIOLOGY AND MICROBIAL GENETICS**

**TOTAL HOURS: 48**

**CREDITS: 2**

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

**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.

# V<sup>th</sup> SEMEISTER PAPERS

**THERE WILL BE THREE PAIRS OF EACH DOMAIN OF CORE COURSE.**

**STUDENT HAS TO CHOOSE ONE PAIR FROM EACH DOMAIN.**

## A – PAIR

**B.Sc MICROBIOLOGY (CBCS) REVISED SYLLABUS – 2020-21**

### **MBT A1 – FOOD, AGRICULTURE AND ENVIRONMENTAL MICROBIOLOGY**

#### **UNIT – 1**

**No.of Hours:8**

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

#### **UNIT – II**

**No.of Hours:8**

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:8**

Soil Microbiology: Microbial groups in soil, microbial transformations of carbon, nitrogen, phosphorus and sulphur, Biological nitrogen fixation. Microflora of Rhizosphere and Phyllosphere microflora, microbes in composting. Importance of mycorrhizal inoculums, types of mycorrhizae associated plants, mass inoculums. Production of VAM, field applications of Ectomycorrhizae and VAM.

#### **UNIT - IV**

**No.of Hours:8**

Beneficial microorganisms in Agriculture: Biofertilizer (Bacterial Cyanobacterial and Fungal), microbial insecticides, Microbial agents for control of Plant diseases, Biodegradation, Biogas production, Biodegradable plastics, Plant – Microbe interactions.  
Diseases caused by bacteria and fungi to various commercial and food crops (2 examples each)  
Management of soil biota for maintaining soil fertility. Conversion of waste lands into fertile lands.  
Management of soil nutrients.

#### **UNIT – V**

**No.of Hours: 12**

Terrestrial Environment: Soil profile and soil microflora. Aquatic Environment: Microflora of fresh water and marine habitats. Atmosphere: Aeromicroflora and dispersal of microbes.

Extremophiles. Nutrient cycling - Carbon, nitrogen, phosphorus. Methods to detect portability of water samples.

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.

## **MBP A1 – FOOD, AGRICULTURE AND ENVIRONMENTAL MICROBIOLOGY**

**Total hours: 40**

**Credits: 2**

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

### **SUGGESTED READINGS:**

- Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition, Benjamin/Cummings Science Publishing, USA
- Barton LL & Northup DE (2011). Microbial Ecology. 1st edition, Wiley Blackwell, USA
- Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England.



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

## **B.Sc MICROBIOLOGY (CBCS) REVISED SYLLABUS – 2020-21**

### **MBT A2 – MANAGEMENT OF HUMAN MICROBIAL DISEASES AND DIAGNOSIS**

#### **UNIT – I**

**No.of Hours: 8**

Definition and concept of health, disease, infection, and pathogen. Bacterial, Viral, Fungal and Protozoan Diseases of various human body systems. Disease associated clinical samples for diagnosis - any three diseases of each.

**UNIT- II****No. of hours: 8**

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

Method of transport of clinical samples to laboratory and storage.

**UNIT- III****No. of hours: 8**

Mechanism of bacterial pathogenicity, colonization and growth, virulence, virulence factors, exotoxins, enterotoxins, endotoxins and neurotoxins.

Examination of sample by staining - Gram stain, Ziehl-Neelson staining for tuberculosis, Giemsa-stained thin blood film for malaria.

Preparation and use of culture media - Blood agar, Chocolate agar, Lowenstein-Jensen medium, MacConkey agar, Distinct colony properties of various bacterial pathogens.

**UNIT- IV****No. of hours: 6**

Serological Methods - Agglutination, ELISA, immunofluorescence, Nucleic acid based methods - PCR, Nucleic acid probes.

Diagnosis of Typhoid, Dengue and HIV, Swine flu. Role of vectors- biology of vectors. (1) House fly (2) Mosquitoes (3) sand fly.

**UNIT- V****No. of hours: 6**

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

**MBP- AII: MICROBIAL DIAGNOSIS IN HEALTH CLINICS****TOTAL HOURS: 40****CREDITS: 2**

1. Collection transport and processing of clinical specimens (Blood, Urine, Stool and Sputum). Receipts, Labeling, recording and dispatching clinical specimens.
2. Physical, Chemical & microscopic examination of clinical samples – urine, stool, puss, sputum.

3. Isolation and identification of following pathogens from clinical samples: *E.coli*, *Salmonella* and *Pseudomonas*.
4. Demonstration of permanent slides of the following parasites:
  - a) *Entamoeba histolytica*
  - b) *Ascaris spp.*
  - c) *Plasmodium spp.*
  - d) *Mycobacterium tuberculosis* & *Mycobacterium leprae*
5. Estimation of hemoglobin (Acid hematin and cyan methanoglobin method).
6. ESR and PCV determination.
7. Immuno hematology: Blood group typing by slide test & tube for ABO & Rh systems.
8. Isolation of bacteria in pure culture and Antibiotic sensitivity.

### **SUGGESTED READING**

- Ananthanarayan R and Paniker CKJ (2009) Textbook of Microbiology, 8th edition, Universities Press Private Ltd.
- 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.
- Collee JG, Fraser, AG, Marmion, BP, Simmons A (2007) Mackie and McCartney Practical Medical Microbiology, 14th edition, Elsevier.
- Randhawa, VS, Mehta G and Sharma KB (2009) Practicals and Viva in Medical Microbiology 2nd edition, Elsevier India Pvt Ltd.
- Tille P (2013) Bailey's and Scott's Diagnostic Microbiology, 13th edition, Mosby.

## B – PAIR

### **B.Sc MICROBIOLOGY (CBCS) REVISED SYLLABUS – 2020-21**

#### **MBT BI – MICROBIAL BIOTECHNOLOGY AND r – DNA TECHNOLOGY**

**TOTAL HOURS: 36**

**CREDITS: 3**

#### **UNIT – I**

**No. of hours: 8**

Introduction to microbial biotechnology, Bacterial genes, genomes and genetics. Recombinant microbial biotechnology products, biotechnology regulation and ethics. **Restriction and Modification:** Classification of restriction endonucleases. Enzymes used in molecular cloning; Polymerases, ligases, phosphatases, kinases and nucleases; Advanced Molecular biology techniques, Electrophoresis and Blotting techniques.

#### **UNIT- II**

**No. of hours: 8**

**Cutting and joining DNA:** (cohesive end ligation, methods of blunt end ligation).

Transfection and transformation. Selection of transformed cells. Screening methods (Genetic marker and blue white screening).

Biomass and bio fuels: plant biomass (cellulose, starch, pectin, gum materials). Animal biomass (chitin, milk, whey, slaughter, house waste). Microbial biomass (algal blooms, in fresh and sea water), fungal mushrooms, fermentation waters by yeasts, and bacterial biomass.

#### **UNIT- III**

**No. of hours: 7**

**Cloning vehicles** - Plasmid, Bacteriophage, Construction of genomic and cDNA libraries.

Advantages of cDNA libraries. Concept of single cell proteins, probiotics and their applications. Microbial production of fuels: alcohols, hydrogen and methane. Microbial production of polymers: xanthenes gums.

#### **UNIT- IV**

**No. of hours: 7**

Methods of gene sequencing – Maxam - Gilberts and Sanger's dideoxy chain termination methods; Polymerase chain reaction technique (Components in PCR and PCR conditions).

Methods of gene transfer in fungi, yeast and higher plants using microinjection, microprojectile bombardment (gene gun method, Electroporation and *Agrobacterium* mediated transformation).

Expression of cloned genes in bacteria, yeast, plant and animal cells. Basic principles and application of biosensors. Nucleic acid probe technology.

**UNIT- V**

**No. of hours: 7**

Concept of genetically modified microorganisms. Bt cotton : production, advantages and limitations.

Probable advantages and disadvantages of genetically modified crops. Role of microorganisms in creation of transgenic animals and plants.

**MBT- BI : MICROBIAL BIOTECHNOLOGY AND r – DNA TECHNOLOGY**

**TOTAL HOURS: 36**

**CREDITS: 2**

1. Culturing of mushrooms
2. Isolation of yeast from grapes.
3. Production of wine
4. Production of ethyl alcohol
5. Isolation of Plasmid DNA from E.coli
6. Tissue culture: callus cultivation
7. Fermentative production of ethyl alcohol
8. Transformation in Bacteria using plasmid.
9. Restriction digestion of DNA and its electrophoretic separation.
10. Ligation of DNA molecules and their testing using electrophoresis.
11. Activity of DNAase and RNAse on DNA and RNA.
12. Isolation of Plasmid DNA.
13. Demonstration of PCR.

**B.Sc MICROBIOLOGY (CBCS) REVISED SYLLABUS – 2020-21**

**MBT B2 – BIOSTATISTICS AND BIOINFORMATICS**

**TOTAL HOURS: 36**

**CREDITS: 3**

**UNIT – I**

**No.of hours: 7**

Definition, nature and scope of bioinformatics. Bioinformatics versus computational biology. Branches of bioinformatics. Basic concepts in bioinformatics. Introduction to Biological data bases: NCBI, EMBL, EXPASY, PIR, Pfam. Concept of World Wide Web: HTML, HTTP.

**UNIT – II**

Searching sequence data bases using BLAST. Multiple sequence alignment– progressive alignment–profiles–multi dimensional dynamic programming. Biostatistics: Measures of Central tendency and distribution–mean, median, mode, range, standard deviation, variance.

**UNIT – III**

**No.of hours: 7**

Basic principles of probability theory, Bayes theorem, Normal distribution, statistical inference – Types of errors and levels of significance. Comparison of variance (F-test), small sample test, t-test for comparison of means, chi square test. Analysis of variance–one way and two way, multiple comprises.

**UNIT – IV**

**No.of hours: 7**

Correlation and Linear regression. Sequence Analysis: Introduction to hidden Markov models. Genomics and proteomics: Molecular phylogenetics: Construction of Phylogenetic trees using parsimony method and branch & bound method. Clustering methods– UPGMA & neighbor-joining. Fragment assembly, peptide sequencing using mass and spectroscopy data. Comparative genomics.

**UNIT – V**

**No.of hours: 8**

Modeling: Protein secondary structure prediction–Chou Fasmanrules– Neural networks–discriminant analysis. Prediction of transmembrane segments in Membrane proteins. Protein3D structure prediction– homology– threading – Potential energy functions–energy minimization–molecular dynamics–simulated annealing.

## **MBP B2 - BIOSTATISTICS AND BIOINFORMATICS**

**TOTAL HOURS: 36**

**CREDITS: 2**

1. Isolation of plasmid DNA from *E.coli* cells
2. Quantitative and qualitative analysis of proteins / DNA by using spectrophotometer.
3. Demonstration of Southern hybridization
4. Demonstration of amplification DNA by PCR.
5. Use of software for sequence analysis of nucleotides and proteins.
6. Problem related to t – test and  $\chi^2$  test.
7. Use of Internet/software for sequence analysis of nucleotides and proteins:
8. Studies of public domain data bases for nucleic acid and protein sequences.
9. Determination of protein structure (PDB).
10. Genome sequence analysis
11. Problems related to measures of central tendency, dispersion, t-test and chi Square test.

### **SUGGESTED READINGS:**

1. Daniel, 2006, Biostatistics, Eighth Edition. John Wiley and sons.
2. Durbin, Eddy, Krogh, Mithison, Biological sequence analysis.
3. T.A.AttwoodandD.J.parry–smith, 2001, Introduction of Bioinformatics.
4. A.D.Baxevaris,1998, Bioinformatics:Apracticalguidetotheanalysisof Genes and proteins,(Edited) B.F.Publication.
5. David W, 2005, Bio-informatics;sequenceandGenomeAnalysis,2<sup>nd</sup>Edition By Mount CB Spublishers.

## **C – PAIR**

**B.Sc MICROBIOLOGY (CBCS) REVISED SYLLABUS – 2020-21**

### **MBT CI – MICROBIAL QUALITY CONTROL INSTRUMENTATION AND TECHNIQUES**

**TOTAL HOURS: 36**

**CREDITS: 3**

#### **UNIT – I**

**No.of hours:7**

Microbial quality control definition, history and introduction. Standard Methods involved in assessment of microbial quality control. Q.A and Q.C definitions and importance. Traditional Microbiological Quality Controlling methods: Sampling methods, TVC, APC and serial dilution techniques. Microbiological criteria. Laboratory facility design for quality control: Sterilization, disinfection and decontamination. Personnel training: Hygiene and handling techniques. Documentation. Good laboratory practices.

#### **UNIT – II**

**No.of hours: 8**

Culture media used in QC and QA: Design of specialized media for identification of pathogens. Good laboratory practices in culture media preparation: raw material, water, pH. Uses of media. Selective and indicator media used in pharmaceutical and food industries. Instruments associated in QC and QA: Principle involved, working conditions, uses and precautions of Laminar Air Flow (LAF), Autoclave, Incubator, pH meter, Colony counter, Hot air oven, Centrifuges and storage devices.

#### **UNIT – III**

**No.of hours: 7**

Techniques for enumeration of microorganisms: sample preparation from Aqueous, soluble, insoluble, medical and pasteurized materials. Counting methods: pour plate, spread plate, membrane filtration. Most Probable Number (MPN) and MIC. Turbidimetric methods. Staining techniques for identification bacteria and Fungi.

#### **UNIT – IV**

**No.of hours:7**

Microscopy – Principles of light, phase, fluorescent & electron microscopes; Microscopic techniques: Basic principles and applications of phase – contrast microscopy, fluorescent microscopy and electron microscopy, types of electron microscopy– scanning and transmission.



Radio isotopes: radiometric analysis, stable and radioactive isotopes, preparation, labeling, detection and measurement of isotope.

### **UNIT - V**

**No.of hours:7**

Principles of Centrifugation – Centrifugation techniques – preparative and analytical methods, density gradient centrifugation. General principles and applications of chromatography – Paper, Column, Thin layer, Gas, Ion exchange, Affinity chromatography, HPLC, FPLC, GCMS and Gel filtration. Electrophoresis- moving boundary, zone (Paper Gel) electrophoresis. Immuno electrophoresis. Immuno blotting. Isoelectric focusing, 2-Delectrophoresis, Principles of colorimetry

### **MBP-C1 : MICROBIAL INSTRUMENTATION AND BIOTECHNIQUES**

**Total hours: 36**

**Credits: 2**

1. Isolation and enumeration of bacteria form food / pharmaceutical source.
2. Quality Assurance of water by MPN method.
3. Preparation of any two selective and indicator media commonly used Q.A & Q.C
4. Microbial quality of in and around laboratory conditions.
5. Isolation and Identification of fungi by using selective media and staining procedures.
6. Identification of MIC of any one antibiotic.
7. Colorimetric and spectroscopic estimation of nucleic acids.
8. Microscopic observations of examination of bacteria, fungi and actinomycetes.
9. Separation of cell components by centrifugation technique.
10. Demonstration of immune electrophoresis.
11. Demonstration of HPLC.

### **Suggested readings:**

1. Hand book of Microbial Quality control by Rosamund. M, Baird Norman. A, Hodges and Stephen. P, Denyer. CRC press.
2. The Microbiological Quality of Food, 1st Edition, Editors: Antonio Bevilacqua Maria Rosaria Corbo Milena Sinigaglia eBook ISBN: 9780081005033 Imprint:Wood head Publishing.

3. Guide to Microbiological Control in Pharmaceuticals and Medical Devices, Second Edition, Stephen P. Denyer, Rosamund M. Baird, CRC Press.
4. WILSON & WALKER, Practical Biochemistry: Principles and techniques, Academic publishers.
5. UPADHYAY, UPADHYAY & NATH, Biophysical Chemistry: Principles and techniques, Himalaya Publishers.

## **B.Sc MICROBIOLOGY (CBCS) REVISED SYLLABUS – 2020-21**

### **MBT – C2: DRUG DESIGN, DISCOVERY AND INTELLECTUAL PROPERTY RIGHTS**

#### **(IPR)**

**TOTAL HOURS: 36**

**CREDITS: 3**

#### **Unit – I**

**No. of Hours: 7**

Introduction- History of drug design, Current approaches and philosophies in drug design, Molecular mechanisms of diseases and drug action with examples. Pharmaceutical products of microbial origin (antibiotics) animal origin (sex hormones), plant origin (Alkaloids & Morphine). Sources of Drugs- Microbial drugs, Plants as a source of drugs, *E. coli* as a source of recombinant therapeutic proteins.

#### **Unit – II**

**No. of Hours: 7**

Expression of recombinant proteins in yeasts, animal cell culture systems.. Rational drug design and Combinatorial approaches to drug discovery. Drug development process- Impact of genomics and related technologies upon drug discovery: Gene chips, Proteomics, Structural genomics and Pharmacogenetics. Drug manufacturing process- Guides to good manufacturing practice.

#### **Unit – III**

**No. of Hours: 7**

Vaccines and adjuvant- Traditional vaccine preparations, Attenuated and inactivated viral and bacterial vaccines, Toxoids. Peptide vaccines. Adjuvant technology. Nucleic acid as drugs- Gene therapy: Basic approach to gene therapy, Vectors used in gene therapy - Manufacture of viral vectors, Non-viral vectors. Gene therapy and genetic disease, cancer, Gene therapy and AIDS. Gene based vaccines.

**Unit – IV****No. of Hours: 8**

Introduction: general introduction to IPR (parent, plant breeder's right). Trademarks, industrial design, trade secrets (or) undisclosed information integrated circuit designs.

Patenting principle, international – standards and patent validity (neem and relaxins), recent developments in patent system and patentability of biotechnology, invention IPR issues of the Indian context. Copy right and rights related to copy right, International standards as per WHO, ISI, bio safety and validation.

**Unit – V****No. of Hours: 7**

Biotechnology and hunger: challenges for the Indian biotechnological research and industries. Bio safety: the Cartagena protocol on bio safety.

Bio safety management: key to the environmentally responsible use of biotechnology, ethical implications of biotechnology product techniques, social and ethical implications of biological weapons

**MBT – C2: DRUG DESIGN, DISCOVERY AND INTELECTUAL PROPERTY RIGHTS****(IPR)****TOTAL HOURS: 40****CREDITS: 3**

1. Isolation of antibiotic producing bacteria from soil samples
2. Isolation of drug resistant plasmid from bacteria (E.coli).
3. Isolation of Actinomycetes from soil.
4. Identification of antibacterial activity of actinomycetes.
5. Identification of antibacterial activity of fungi
6. Identification of antagonistic activity of any two fungal species.
7. Assay of any one antibiotic (Penicillin).
8. Determination of MIC of any one antibiotic (penicillin / streptomycin).
9. Study of components and design of a BSL – III laboratory
10. Filing applications for approval from bio safety committee
11. Filing primary applications for patents
12. Study of steps of patenting process
13. A case study of patent.

14. Study of bio safety measures in pharmaceutical industry.
15. Study on QA & QC parameters followed in R&D laboratory.

**SUGGESTED READINGS:**

1. W.B.Hugo & A.D.Russell, Pharmaceutical Microbiology edited, 6<sup>th</sup> Edition, Black Well science.
2. Shanson D.C., Microbiology in clinical practice, 2<sup>nd</sup> edition, London; Wright.
3. T Sammes Ellis Horwood, opiesin Antibiotic chemistry Vol I to V.
4. Wulf Crueger, Biotechnology – A text book of Industrial Microbiology, 2<sup>nd</sup> Edition, Panima publishers
5. A.H.Patel, 1984, Industrial Microbiology, Macmilan India Limited.
6. Coulson C.J., London; Taylor and Francis, Molecular mechanisms of drug action.
7. Denyes S.P. & Baird R.M. Chichester, Ellis Horwood, Guide to microbiological Control in Pharmaceuticals.
8. Murray S. Cooper, Quality control in the Pharmaceutical Industry-Edt., Vol-II, Academic press, New York.
9. Sydney H. Willin, Murray M. Tuckerman, William S. Hitchings IV, Good Manufacturing practices of pharmaceuticals, second Edt., Mercei Dekker NC Nework.
10. Rajesh Bhatia, Rattanlal Ihhpunjani, Quality assurance in Microbiology, CBS Publisher & Distributors, New Delhi.