WEST BENGAL STATE UNIVERSITY

CBCS DRAFT SYLLABUS

FOR

THREE-YEAR MICROBIOLOGY GENERAL

DEGREE COURSE OF STUDIES

Distribution of courses in different semesters for Undergraduate course in **MICROBIOLOGY GENERAL**

Semester	Core	DSE	GE	AECC	SEC	Total credit
I	MCBGCOR01T/P			Environmental Science		20
II	MCBGCOR02T/P			English/MIL Communicatior		20
III	MCBGCOR03T/P				MCBSSEC01M	20
IV	MCBGCOR04T/P				MCBSSEC02M	20
V		MCBGDSE01T/P MCBGDSE02T/P **(Any one)**			XSSEC03M	20
VI		MCBGDSE03T/P MCBGDSE04T/P **(Any one)**			XSSEC04M	20
Total number of courses	12	6	0	2	4	120

X – FROM OTHER DISCIPLINE

MCBGCOR01T(For General Students):

BACTERIOLOGY AND VIROLOGY (THEORY)

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 Cell organization **No. of Hours: 10**

Cell size, shape and arrangements, capsule, flagella and pili, Composition and detailed structure of gram- positive and gram- negative cell wall. Structure, chemical composition and functions of bacterial cell membranes, Ribosomes, inclusions, nucleoid, plasmids, structure of endospore.

Unit 2 Bacterial growth and control **No. of Hours: 8**

Culture media: Components of media, Synthetic or defined media, Complex media, enriched media, selective media, differential media, enrichment culture media, Pure culture isolation: Streaking, serial dilution and plating methods, cultivation, maintenance and stocking of pure cultures, phases of growth

Unit 3 Bacterial Systematics and Taxonomy **No. of Hours: 8**

Taxonomy, nomenclature, systematics, types of classifications, Morphology, ecological significance and economic importance of Gram negative and Gram positive bacteria.

Unit 4 Introduction to Viruses **No. of Hours: 12**

Properties of viruses; general nature and important features Subviral particles; viroids, prions and their importance Isolation and cultivation of viruses

Unit 5 Structure, and multiplication of viruses **No. of Hours: 12**

Morphological characters: Capsid symmetry and different shapes of viruses with examples
Viral multiplication in the Cell: Lytic and lysogenic cycle
Description of important viruses: salient features of the viruses infecting different hosts - Bacteriophages (T4 & Lambda); Plant (TMV & Cauliflower Mosaic Virus), Human (HIV & Hepatitis viruses)

Unit 6 Role of Viruses in Disease and its prevention **No. of Hours: 10**

Viruses as pathogens: Role of viruses in causing diseases, Prevention and control of viruses: Viral vaccines, interferons and antiviral compounds

MCBGCOR01P (For General Students):

BACTERIOLOGY AND VIROLOGY (PRACTICAL)

TOTAL HOURS: 60 **CREDITS: 2**

1. Preparation of different media: Nutrient agar, Nutrient broth
2. To perform Gram's staining of the bacterial smear
3. To perform spore staining
4. Isolation of pure cultures of bacteria by streaking method
5. Enumeration of colony forming units (CFU) count by spread plate method/pour plate

SUGGESTED READING

1. Atlas RM. (1997). Principles of Microbiology. 2nd edition. WM.T.Brown Publishers
2. Madigan MT, Martinko JM, Dunlap PV and Clark DP (2014). Brock Biology of Micro-organisms. 14th edition. Pearson Education, Inc.
3. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology. 5th edition. McMillan
4. Carter J and Saunders V(2007). Virology; principles and Applications. John Wiley and Sons
5. Flint SJ, Enquist, LW, Krug, RM, Racaniello, VR Skalka, AM (2004) Principles of Virology, Molecular Biology, Pathogenesis and Contro*l*.2nd edition.ASM Press

MCBGCOR02T(For General Students)**:**

INDUSTRIAL & FOOD MICROBIOLOGY (THEORY)

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 Introduction to Industrial microbiology **No. of Hours: 10**
Types of fermentation processes - solid state, liquid state, batch, fed-batch and continuous, Types of fermenters – laboratory, pilot-scale and production fermenters, Components of a typical continuously stirred tank bioreactor

Unit 2 Isolation of Industrial Strains and Fermentation Medium **No. of Hours: 8**
Primary and secondary screening, Preservation and maintenance of industrial strains, Ingredients used in fermentation medium - molasses, corn steep liquor, whey & Yeast extract

Unit 3 Microbial fermentation processes **No. of Hours: 12**
Downstream processing - filtration, centrifugation, cell disruption, solvent extraction. Microbial production of industrial products - citric acid, ethanol and penicillin, Industrial production and uses of the enzymes - amylases, proteases.

Unit 4 Food as a substrate for microbial growth **No. of Hours: 9**
Intrinsic and extrinsic parameters that affect microbial growth in food, Microbial spoilage of food - milk, egg, bread and canned foods

Unit 5 Principles and methods of food preservation and food sanitation **No. of Hours: 9**
Physical methods - high temperature, low temperature, irradiation, aseptic packaging Chemical methods - salt, sugar, benzoates, citric acid, ethylene oxide, nitrate and nitrite Food sanitation and control – HACCP

Unit 6 Dairy products, probiotics and Food-borne Diseases **No. of Hours: 12**
Fermented dairy products - yogurt, acidophilus milk, dahi and cheese, Probiotics definition, examples and benefits, Food intoxication by *Clostridium botulinum* and *Staphylococcus aureus*, Food infection by *Salmonella* and *E.coli*

MCBGCOR02P (For General Students)**:**

INDUSTRIAL AND FOOD MICROBIOLOGY (PRACTICAL)

TOTAL HOURS: 60 **CREDITS: 2**

1. Isolation of amylase producing bacteria from soil
2. Determination of the microbiological quality of milk sample by MBRT
3. Isolation of fungi from spoilt bread/fruits/vegetables
4. Preparation of Yogurt/Dahi

SUGGESTED READING

1. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd Edition. Panima Publishing Company, New Delhi
2. Patel AH. (1996). Industrial Microbiology .1st Edition. MacMillan India Limited Publishing Company Ltd. New Delhi, India
3. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An introduction.9th Edition. Pearson Education

MCBGCOR03T (For General Students)**:**

MICROBIAL GENETICS AND MOLECULAR BIOLOGY (THEORY)

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 Structures of DNA and RNA / Genetic Material **No. of Hours: 6**
DNA structure, Salient features of double helix, Types of DNA, denaturation and renaturation, topoisomerases; Organization of DNA in Prokaryotes.

Unit 2 Replication of DNA **No. of Hours: 6**
Bidirectional and unidirectional replication, semi- conservative, semi- discontinuous replication Mechanism of DNA replication: Enzymes and proteins involved in DNA replication –DNA polymerases, DNA ligase, primase.

Unit 3 Transcription **No. of Hours: 6**
Transcription: Definition, promoter - concept and strength of promoter. Transcriptional Machinery and Mechanism of transcription.

Unit 4 Translation **No. of Hours: 6**
Genetic code, Translational machinery, Charging of tRNA, aminoacyl tRNA synthetases, Mechanisms of initiation, elongation and termination of polypeptides.

Unit 5 Regulation of gene Expression **No. of Hours: 3**
Principles of transcriptional regulation, regulation at initiation with examples from *lac* operon.

Unit 6 Mutations **No. of Hours: 8**
Mutations and mutagenesis: Definition and types of Mutations; Physical and chemical mutagens.

Unit 7 Modes of Genetic Exchange in bactetia **No. of Hours: 10**
Transformation - Discovery, mechanism of natural competence Conjugation - Discovery, mechanism, Hfr and F' strains. Transduction - Generalized transduction, specialized transduction

Unit 8 Introduction to genetic engineering **No. of Hours: 15**
Restriction modification systems: Type II restriction enzymes in genetic engineering, DNA modifying enzymes: DNA polymerases, Terminal deoxynucleotidyl transferase, kinases and phosphatases, and DNA ligases.
Cloning Vectors: Definition and Properties Plasmid vectors: pBR and pUC series
PCR: Basics of PCR.

MCBGCOR03P (For General Students)**:**

MICROBIAL GENETICS & MOLECULAR BIOLOGY (PRACTICAL)

TOTAL HOURS: 60 **CREDITS: 2**

1. Demonstration of transformation experiment in *E.coli*
2. Demonstration of Bacterial conjugation

MCBGCOR04T (For General Students)**:**
MEDICAL MICROBIOLOGY AND IMMUNOLOGY (THEORY)

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 Normal microflora of the human body and host pathogen interaction

No. of Hours: 10

Normal microflora of the human body: Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract, Host pathogen interaction: Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections, Nosocomial infections. Transmission of infection

Unit 2 Bacterial diseases **No. of Hours: 4**

List of diseases of various organ systems and their causative agents. (Meningitis, tuberculosis, leprosy, cholera, diphtheria, whooping cough, tetanus)

Unit 3 Viral diseases **No. of Hours: 3**

List of diseases of various organ systems and their causative agents. (polio, influenza, pox, mumps, measles, rubella)

Unit 4 Protozoan diseases **No. of Hours: 2**

List of diseases of various organ systems and their causative agents.(Amoebic dysentery, malaria)

Unit 5 Fungal diseases **No. of Hours: 3**

Brief description of various types of mycoses.

Unit 6 Antimicrobial agents: General characteristics and mode of action

No. of Hours:10

Antibacterial agents: Five modes of action with one example each: Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function; Inhibitor of protein synthesis; Inhibitor of metabolism, Antifungal agents: Amphotericin B, Griseofulvin, Antiviral agents: Amantadine, Acyclovir, Azidothymidine

Unit 7 Immune Cells and Organs **No. of Hours: 8**

Structure, Functions and Properties of: Immune Cells – Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell; and Immune Organs – Bone Marrow, Thymus.

Unit 8 Antigens and Antibodies **No. of Hours: 8**

Characteristics of an antigen (Foreignness, Molecular size and Heterogeneity); Haptens; Epitopes (T& B cell epitopes), Adjuvants, Structure, Types and Functions of antibodies.

Unit 9 Generation of Immune Response **No. of Hours: 6**

Primary and Secondary Immune Response; Generation of Humoral Immune Response (Plasma and Memory cells); Generation of Cell Mediated Immune Response

Unit 10 Immunological Techniques **No. of Hours: 6**

Principles of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, ELISA

MCBGCOR04P (For General Students):
MEDICAL MICROBIOLOGY AND IMMUNOLOGY (PRACTICAL)
TOTAL HOURS: 60 **CREDITS: 2**

1. Identify bacteria on the basis of biochemical characteristics: IMViC, nitrate reduction, urease production and catalase tests
2. Perform antibacterial sensitivity by Kirby-Bauer method
3. Identification of human blood groups.
4. To perform immunodiffusion by Ouchterlony method.

SUGGESTED READING

1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
3. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4th edition. Elsevier
4. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology, 9th edition. McGraw Hill Higher Education

DSE FOR B.Sc. GENERAL PROGRAMME:

MCBGDSE01T: INSTRUMENTATION AND BIOTECHNIQUES (THEORY)

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 Microscopy **No. of Hours: 10**

Brightfield and darkfield microscopy, Fluorescence Microscopy, Phase contrast Microscopy, Confocal Microscopy, Electron Microscopy (Scanning and Transmission Electron Microscopy).

Unit 2 Chromatography **No. of Hours: 14**

Principles and applications of paper chromatography (including Descending and 2-D), Thin layer chromatography. Column packing and fraction collection, Gel filtration chromatography, ion- exchange chromatography and affinity chromatography, GLC, HPLC.

Unit 3 Electrophoresis **No. of Hours: 14**

Principle and applications of native polyacrylamide gel electrophoresis, SDS-polyacrylamide gel electrophoresis, 2D gel electrophoresis, Isoelectric focusing, Zymogram preparation and Agarose gel electrophoresis.

Unit 4 Spectrophotometry **No. of Hours: 10**

Principle and use of study of absorption spectra of biomolecules, Analysis of biomolecules using UV and visible range, Colorimetry and turbidometry

Unit 5 Centrifugation **No. of Hours: 12**

Preparative and analytical centrifugation, fixed angle and swinging bucket rotors. RCF and sedimentation coefficient, differential centrifugation, density gradient centrifugation and ultracentrifugation

MCBGDSE01P : INSTRUMENTATION AND BIOTECHNIQUES (PRACTICAL)

TOTAL HOURS: 60 **CREDITS: 2**

1. Separation of amino acid mixtures by thin layer chromatography.
2. Separation of protein mixtures by any form of chromatography.
3. Separation of protein mixtures by Polyacrylamide Gel Electrophoresis (PAGE).
4. Determination of λ_{max} for an unknown sample and calculation of extinction coefficient.
5. Separation of components of a given mixture using a laboratory scale centrifuge.

SUGGESTED READINGS

1. Wilson K and Walker J. (2010). Principles and Techniques of Biochemistry and Molecular Biology. 7th Ed., Cambridge University Press.
2. Nelson DL and Cox MM. (2008). Lehninger Principles of Biochemistry, 5th Ed., W.H. Freeman and Company.
3. Willey MJ, Sherwood LM & Woolverton C J. (2013). Prescott, Harley and Klein's Microbiology. 9thEd., McGraw Hill.
4. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons. Inc.
5. De Robertis EDP and De Robertis EMF. (2006). Cell and Molecular Biology. 8th edition. Lipincott Williams and Wilkins, Philadelphia.
6. Cooper G.M. and Hausman R.E. (2009). The Cell: A Molecular Approach. 5th Edition. ASM Press & Sunderland, Washington D.C., Sinauer Associates, MA.
7. Nigam A and Ayyagari A. 2007. Lab Manual in Biochemistry, Immunology and Biotechnology. Tata McGraw Hill.

MCBGDSE02T: INHERITANCE BIOLOGY (THEORY)

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 Introduction to Genetics **No. of Hours: 5**

Historical development, Model organisms in genetic analyses and experimentation: *Escherichia coli*, *Saccharomyces cerevisiae, Drosophila melanogaster, Arabidopsis thaliana*

Unit 2 Mendelian Principles **No. of Hours: 13**

Mendel's Laws: Dominance, segregation, independent assortment, deviation from Mendelian inheritance, Rediscovery of Mendel's principles, Chromosome theory of inheritance: Allele, multiple alleles, pseudoallele, complementation tests, Extensions of Mendelian genetics: Allelic interactions, concept of dominance, recessiveness, Incomplete dominance and co-dominance.

Unit 3 Linkage and Crossing over **No. of Hours: 6**

Linkage and recombination of genes, Cytological basis of crossing over.

Unit 4 Extra-Chromosomal Inheritance **No. of Hours: 9**

Extra nuclear inheritance in bacteria: Plasmid and episome, Organelle heredity – Chloroplast, Mitochondria,

Unit 5 Characteristics of Chromosomes **No. of Hours: 8**

Structural organization of chromosomes - centromeres, telomeres and repetitive DNA, Packaging DNA molecules into chromosomes, Concept of euchromatin and heterochromatin, Chromosome banding, Giant chromosomes: Polytene and lampbrush chromosomes,

Unit 6 Recombination **No. of Hours: 7**

Homologous and non-homologous recombination, including transposition, site-specific recombination.

Unit 7 Human genetics **No. of Hours: 12**

Karyotyping and genetic disorders: Variations in chromosome structure: Deletion, duplication, inversion and translocation, Variation in chromosomal number and structural abnormalities - Klinefelter syndrome, Turner syndrome, Down syndrome.

MCBGDSE02P: INHERITANCE BIOLOGY (PRACTICAL)

TOTAL HOURS: 60 **CREDITS: 2**

1. Chi-Square Analysis of Mendelian monohybrid/dihybrid cross
2. Study of polytene chromosomes using temporary mounts of salivary glands of *Chiromonas / Drosophila* larvae

SUGGESTED READING

1. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India
2. Snustad DP, Simmons MJ (2011). Principles of Genetics. 6th Ed. John Wiley and Sons Inc.
3. Weaver RF, Hedrick PW (1997). Genetics. 3rd Ed. McGraw-Hill Education

4. Klug WS, Cummings MR, Spencer CA, Palladino M (2012). Concepts of Genetics. 10th Ed. Benjamin Cummings
5. Griffith AJF, Wessler SR, Lewontin RC, Carroll SB. (2007). Introduction to Genetic Analysis. 9th Ed. W.H.Freeman and Co., New York
6. Hartl DL, Jones EW (2009). Genetics: Analysis of Genes and Genomes. 7th Ed, Jones and Bartlett Publishers
7. Russell PJ. (2009). *i* Genetics - A Molecular Approach. 3rd Ed, Benjamin Cummings

MCBGDSE03T: MICROBES IN SUSTAINABLE AGRICULTURE AND DEVELOPMENT (THEORY)

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 Soil Microbiology **No of Hours: 9**
Soil as Microbial Habitat, Soil profile and properties, Soil formation, Diversity and distribution of microorganisms in soil

Unit 2 Microbial Activity in Soil and Green House Gases **No of Hours: 6**
Carbon dioxide, methane, nitrous oxide, nitric oxide – production and control

Unit 3 Microbial Control of Soil Borne Plant Pathogens **No of Hours: 9**
Biocontrol mechanisms and ways, Microorganisms used as biocontrol agents against Microbial plant pathogens, Insects.

Unit 4 Biofertilization, Phytostimulation, Bioinsecticides **No of Hours: 16**
Plant growth promoting bateria, biofertilizers – symbiotic (*Bradyrhizobium, Rhizobium, Frankia*), Non Symbiotic (*Azospirillum, Azotobacter*, Mycorrhizae), Phosphate solubilizers.

Unit 5 Secondary Agriculture Biotechnology **No of Hours: 12**
Biomanure, biogas, biofuels – general concepts and advantages

Unit 6 Genetically Modified crops **No of Hours: 8**
Bt crops, golden rice, transgenic animals, advantages, social and environmental aspects.

MCBGDSE03P: MICROBES IN SUSTAINABLE AGRICULTURE AND DEVELOPMENT (PRACTICAL)

TOTAL HOURS: 60 **CREDITS: 2**

1. Study of microflora of rhizospheric soil different types of soils
2. Isolation and characterization of phosphate solubilizing bacteria from soil
3. Isolation and characterization of Nitrogen fixing bacteria from soil
4. Isolation of *Rhizobium* from root nodules
5. Soil dehydrogenase assay

SUGGESTED READINGS

1. Agrios GN. (2006). Plant Pathology. 5th edition. Academic press, San Diego,
2. Singh RS. (1998). Plant Diseases Management. 7th edition. Oxford & IBH, New Delhi.
3. Glick BR, Pasternak JJ, and Patten CL (2010) Molecular Biotechnology 4th edition, ASM Press,
4. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA
5. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press
6. Barton LL & Northup DE (2011). Microbial Ecology. 1st edition, Wiley Blackwell, USA
7. Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
8. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.
9. Altman A (1998). Agriculture Biotechnology, Ist edition, Marcel decker Inc.
10. Mahendra K. Rai (2005). Hand Book of Microbial Biofertilizers, The Haworth Press, Inc. New York.
11. Reddy, S.M. et. al. (2002). Bioinoculants for Sustainable Agriculture and Forestry, Scientific Publishers.
12. Saleem F and Shakoori AR (2012) Development of Bioinsecticide, Lap Lambert Academic Publishing GmbH KG

MCBGDSE04T: BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTS (THEORY)

TOTAL HOURS: 60
CREDITS: 4

Unit 1 **No of Hours: 16**

Concept of IPR, Designs, trademarks, trade secrets, domain names, geographical indications, copyright, Evolution of patent laws, hist ory of Indian patent system, Agreements and Treaties: GATT, TRIPS Agreements; Role of Madrid Agreement; Hague Agreement;

WIPO Treaties; Budapest Treaty on international recognition of the deposit of microorganisms;

UPOV & Brene conventions; Patent Co-operation Treaty (PCT); Indian Patent Act 1970 & recent

amendments. Classification of patents in India,

Unit 2 **No of Hours: 12**

classification of patents by WIPO, categories of patent, special patents, patenting biological products, Patentable inventions in India and abroad, non patentable inventions in India and abroad, Rights of patent holder and co-owners, transfer of patent rights, limitations of patent rights.

Unit 3 **No of Hours: 12**

Overview of biosafety, risk assessment, cartagena protocol on biosafety, capacity building, GMOs Transgenic technology, future opportunities and challenges, Regulatory measures for biosafety, biosafety guidelines in India evolved by DBT.

Unit 4 **No of Hours: 12**

Prevention food adulteration act, food and safety standard bill and seed policy, rules for the manufacture and storage of hazardous, biosafety management, Some of the products development from RDT and their biosafety issues, biosafety and Gene therapy, ecological safety assessment of recombinant organisms

Unit 5 **No of Hours: 8**

Bioethics and its scope, different approaches to ethics, biological weapons and their social and ethical implications, Importance of good laboratory practices, general good laboratory practices

MCBGDSE04P: BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTS (PRACTICAL)

TOTAL HOURS: 60

CREDITS: 2

Standardization of contamination free environment in laboratory practices. Biochemical and Microbiological analysis of Foods. Food adulteration and its Testing / Anlysis

Suggested Reading

1. Bare Act, 2007.Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., New Delhi.

2. Goel D & Prashar S (2013). IPR, Biosafety and Bioethics. Pearson

SEC COURSES FOR B.SC GENERAL PROGRAMME IN MICROBIOLOGY

MCBSSEC01M: FOOD FERMENTATION TECHNIQUES

TOTAL HOURS: 30
CREDITS: 2

Unit 1 Fermented Foods **No of Hours: 4**

Definition, types, advantages and health benefits

Unit 2 Milk Based Fermented Foods **No of Hours: 8**

Dahi, Yogurt, Buttermilk (Chach) and cheese: Preparation of inoculums, types of microorganisms and production process

Unit 3 Grain Based Fermented Foods **No of Hours: 6**

Soy sauce, Bread, Idli and Dosa: Microorganisms and production process

Unit 4 Vegetable Based Fermented Foods **No of Hours: 4**

Pickels, Saeurkraut: Microorganisms and production process

Unit 5 Fermented Meat and Fish **No of Hours: 4**

Types, microorganisms involved, fermentation process

Unit 6 Probiotic Foods **No of Hours: 4**

Definition, types, microorganisms and health benefits

Suggested Readings

1. Hui YH, Meunier-Goddik L, Josephsen J, Nip WK, Stanfield PS (2004) Handbook of food and

fermentation technology, CRC Press

2. Holzapfel W (2014) Advances in Fermented Foods and Beverages, Woodhead Publishing.

3. Yadav JS, Grover, S and Batish VK (1993) A comprehensive dairy microbiology, Metropolitan

4. Jay JM, Loessner MJ, Golden DA (2005) Modern Food Microbiology, 7th edition. Springer

MCBSSEC02M: MICROBIOLOGICAL ANALYSIS OF AIR AND WATER

TOTAL HOURS: 30 **CREDITS: 2**

Unit 1 Aeromicrobiology **No of Hours: 4**

Bioaerosols, Air borne microorganisms (bacteria, Viruses, fungi) and their impact on human health and environment, significance in food and pharma industries and operation theatres, allergens

Unit 2 Air Sample Collection and Analysis **No of Hours: 7**

Bioaerosol sampling, air samplers, methods of analysis, CFU, culture media for bacteria and fungi, Identification characteristics

Unit 3 Control Measures **No of Hours: 4**

Fate of bioaerosols, inactivation mechanisms – UV light, HEPA filters, desiccation, Incineration

Unit 4 Water Microbiology **No of Hours: 4**

Water borne pathogens, water borne diseases

Unit 5 Microbiological Analysis of Water **No of Hours: 7**

Sample Collection, Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive/MPN tests, confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests

Unit 6 Control Measures **No of Hours: 4**

Precipitation, chemical disinfection, filtration, high temperature, UV light

Suggested Reading

1. da Silva N, Taniwaki MH, Junqueira VC, Silveira N, Nascimento MS, Gomes RAR (2012) Microbiological Examination Methods of Food and WaterA Laboratory Manual, CRC Press

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

3. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press

4. Hurst CJ, Crawford RL, Garland JL, Lipson DA (2007) Manual of Environmental Microbiology, 3rd edition, ASM press edition, ASM press

SEC SYLLABUS OF MICROBIOLOGY (SEMESTER 5 & 6) GENERAL STUDENTS

MCBSSEC003: BIOFERTILIZERS AND BIOPESTICIDES

SEMESTER – V

TOTAL HOURS: 30 **CREDITS: 2**

Unit 1 Biofertilizers No of Hours: 10

General account of the microbes used as biofertilizers for various crop plants and their advantages over chemical fertilizers. Symbiotic N_2 fixers: *Rhizobium* - Isolation, characteristics, types, inoculum production and field application, legume/pulses plants.

Frankia, Cyanobacteria & Azolla - Role in cultivation, Crop response, field application

Unit 2 Non - Symbiotic Nitrogen Fixers No of Hours: 4

Free living bacteria: *Azospirillum, Azotobacter* - isolation, characteristics, mass inoculum production and field application.

Unit 3 Phosphate Solubilizers No of Hours: 4

Phosphate solubilizing microbes - Isolation, characterization, mass inoculum production, field application

Unit 4 Mycorrhizal Biofertilizers No of Hours: 5

Importance of mycorrhizal inoculum, types of mycorrhizae and associated plants, Mass inoculum production of VAM, field applications of Ectomycorrhizae and VAM.

Unit 5 Bioinsecticides No of Hours: 7

General account of microbes used as bioinsecticides and their advantages over synthetic pesticides, Bacillus thuringiensis and Plant viruses – mass production, cultivation and Field applications

SUGGESTED READINGS

1. Kannaiyan, S. (2003). Bioetchnology of Biofertilizers, CHIPS, Texas.

2. Mahendra K. Rai (2005). Hand book of Microbial biofertilizers, The Haworth Press, Inc. New York.

3. Reddy, S.M. et. al. (2002). Bioinoculants for sustainable agriculture and forestry, Scientific Publishers.

4. Subba Rao N.S (1995) Soil microorganisms and plant growth Oxford and IBH publishing co. Pvt. Ltd. NewDelhi.

5. Saleem F and Shakoori AR (2012) Development of Bioinsecticide, Lap Lambert Academic Publishing GmbH KG

6. Aggarwal SK (2005) Advanced Environmental Biotechnology, APH publication.

7. Salle A.J. Fundamental Principals of Bacteriology, Tata Mc.Graw-Hill Publishing, New Delhi

MCBSSEC004: MICROBIAL QUALITY CONTROL IN INDUSTRIES

SEMESTER – VI

TOTAL HOURS: 30 **CREDITS: 2**

Unit 1 Microbiological Laboratory and Safe Practices No. of Hours: 8

Good laboratory practices - Good microbiological practices, Biosafety cabinets – Working of biosafety cabinets, using protective clothing, specification for BSL-1, BSL-2, BSL-3. Discarding biohazardous waste – Methodology of Disinfection, Autoclaving & Incineration

Unit 2 Determining Microbes in Food / Pharmaceutical Samples No. of Hours: 10

Culture and microscopic methods - Standard plate count, Most probable numbers, Direct microscopic counts, Biochemical and immunological methods: Limulus lysate test for endotoxin, ELISA, sterility testing for pharmaceutical products Outline of Molecular methods - Use of PCR in diagnostics, DNA fingerprinting.

Unit 3 Pathogenic Microorganisms of Importance in Food & Water No. of Hours: 8

Enrichment culture technique, Detection of specific microorganisms - on XLD agar, Salmonella Shigella Agar, Manitol salt agar, EMB agar, McConkey Agar, Saboraud Agar Ascertaining microbial quality of milk by MBRT, Rapid detection methods of microbiological quality of milk at milk collection centres (COB, 10 min Resazurin assay)

Unit 4 HACCP for Food Safety and Microbial Standards No. of Hours: 4

Hazard analysis of critical control point (HACCP) - Principles, flow diagrams, limitations Microbial Standards for Different Foods and Water – BIS standards for packaged foods and drinking water

SUGGESTED READINGS

1. Harrigan WF (1998) Laboratory Methods in Food Microbiology, 3rd ed. Academic Press

2. Garg N, Garg KL and Mukerji KG (2010) Laboratory Manual of Food Microbiology I K International Publishing House Pvt. Ltd.

3. Jay JM, Loessner MJ, Golden DA (2005) Modern Food Microbiology, 7th edition. Springer

4. Baird RM, Hodges NA and Denyer SP (2005) Handbook of Microbiological Quality control in Pharmaceutical and Medical Devices, Taylor and Francis Inc.

6. Salle A.J. Fundamental Principals of Bacteriology, Tata Mc.Graw-Hill Publishing, New Delhi

7. Pelczar, Chan & Krieg, Microbiology, Tata Mc.Graw-Hill Publishing, New Delhi

Name and Signatures:

1.Dr. Anushree Mondal Anushree Mondal

2. Dr. Tapti Sengupta Tapti Sengupta 19.11.2020

3. Dr. Mahashweta Mitra Ghosh---------- Mahashweta Mitra Ghosh 19.11.2020

4. Dr. Sandip Bandopadhyay Sandip Bandopadhyay 19.11.20

5. Dr. Nabanita Giri Nabanita Giri 19/11/20

6. Arijit Chaudhuri Arijit Chaudhuri.