

COURSE STRUCTURE & SYLLABUS

(w.e.f. 2020)

M.Sc. Microbiology (CBCS Pattern)

Department of Biosciences
Jamia Millia Islamia

SEMESTER – I		Credits
MBM-101 General Microbiology	4 periods/wk Marks : 60*+40**=100	4
MBM-102 Microbial Cell Biology	4 periods/wk Marks : 60*+40**=100	4
MBM-103 Genetics	4 periods/wk Marks : 60*+40**=100	4
MBM-104 Bioinformatics & Biostatistics (CBCS)	4 periods/wk Marks : 60*+40**=100	4
MBM-105 Lab Course-I	12 periods/wk Marks : 75*+75**=150	6

SEMESTER – II		Credits
MBM-201 Bacteriology	4 periods/wk Marks : 60*+40**=100	4
MBM-202 Virology	4 periods/wk Marks : 60*+40**=100	4
MBM-203 Immunology	4 periods/wk Marks : 60*+40**=100	4
MBM-204 Biochemistry (CBCS)	4 periods/wk Marks : 60*+40**=100	4
MBM-205 Recombinant DNA Technology (SEC)	4 periods/wk Marks : 60*+40**=100	4
MBM-206 Lab Course-II	12 periods/wk Marks : 75*+75**=150	6

SEMESTER – III		Credits
MBM-301 Microbial Diversity	4 periods/wk Marks : 60*+40**=100	4
MBM-302 Eukaryotic Microbiology	4 periods/wk Marks : 60*+40**=100	4
MBM-303 Medical Microbiology	4 periods/wk Marks : 60*+40**=100	4
MBM-304 Environmental Waste Management (CBCS)	4 periods/wk Marks : 60*+40**=100	4
MBM-305 Food Microbiology	4 periods/wk Marks : 60*+40**=100	4
MBM-306 Lab Course-III	16 periods/wk Marks : 100*+100**=200	8

SEMESTER – III		Credits
MBM-401 Technical Writing & Seminar	4 periods/wk Marks : 60*+40**=100	4
MBM-402 Project & Dissertation	16 periods/wk Marks : 100*+100**=200	8
MBM-403 Fermentation Technology (CBCS)	4 periods/wk Marks : 60*+40**=100	4

Total Credits = 92

***Semester End Examination**

****Internal Assessment**

MBM -101

GENERAL MICROBIOLOGY

Unit I

Introduction to microbial systems. Importance of microbiology in agriculture, human health, industry and environment. Types of microorganisms, general characteristics of main groups of microorganisms. Criteria used in the classification of microorganisms- cytology, genetics, host specialization, serology.

Unit II

Preparation and sterilization of culture media using various techniques. Microbial growth: different phases of growth. Measurement of microbial growth. Effects of various environmental factors on microbial growth; Uptake of nutrients by microbial cells and their nutritional requirements. Control of microbial growth: physical control, chemical control and antibiotics.

Unit III

Isolation, culture, identification and preservation of bacteria. Gram positive and gram-negative organisms. Structure and functions of peptidoglycan in gram positive and gram-negative organisms. Functions of polymeric components in outer membrane and acidic polymers in gram-negative organisms. Special features of bacterial metabolism.

Unit IV

Classification of viruses. Virus structure, virus proteins. Virus-host interaction. Replication of RNA viruses (negative strand & positive strand) and DNA viruses (single & double strand). General Characteristic of Viroids, prions, PPLO and recksitsia.

Recommended Books

1. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.
2. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.
3. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education.
4. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.
5. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag

MBM -102

MICROBIAL CELL BIOLOGY

Unit I

Emergence of cellular microbiology. Cellular biology underlying prokaryotic and eukaryotic interactions: ultrastructure, cytoskeletal network, alpha and beta tubulins, actin-myosin system and Dynein activator complex.

Unit II

Prokaryotic and eukaryotic signalling mechanism: eukaryotic cell to cell signalling, endocrine signalling. Cytokines prokaryotic signalling: quorum sensing and bacterial pheromones intracellular signalling. Signalling pathway. Cell interaction; bacterial adherence: basic principles, effect of adhesion on bacteria, effect of adhesion on host cells. Bacterial invasion of host cell: mechanism, consequence of invasion survival after invasion.

Unit III

Overview of extracellular signalling, identification and purification of cell surface receptor, G-protein coupled receptor and their effectors. Protein toxins.

Unit IV

Biological membranes and Transport; Physicochemical properties of cell membranes, molecular constituents of membranes, supramolecular architecture of membranes – a symmetrical organization of lipids and proteins.

Solute transport across membrane: Types of transport, simple diffusion, passive and facilitated diffusions; Active transport. Mobile carrier and pore mechanisms; Transport by vesicle formation: endocytosis, exocytosis; Intracellular communication and cell-cell interaction through junctions; gap junctions, tight junctions and desmosomes.

Recommended Books

1. The Cell, A Molecular Approach – 6th Edition – Geoffrey M. Cooper/Robert E. Hausman- Sinauer Associates, Inc.
2. Molecular Biology of the Cell - 5th Edition - Bruce Alberts et al - Garland Science
3. Molecular Cell Biology - 7th Edition - Harvey Lodish, Arnold Berk & Chris A. Kaiser - W.H. Freeman
4. Lewin's Cells – 2nd Edition – Cassimeris/Lingappa/Plopper – Johns & Bartlett Publishers
5. Cell Biology, A Short Course – 3rd Edition – Stephen R. Bolsover et al – John Wiley & Sons
6. Microbial Physiology: Moat, Foster and Spector
7. Cell and molecular biology: Gerald Karp.
8. Cell and molecular biology: DeRobertis and DeRobertis

MBM -103 GENETICS

Unit I

Chromatin structure, Nucleosome, Chromosome structure-centromere and telomere. Tandomly repeated non-coding DNA Interspersed repeated non-coding DNA Expression and processing of heterogeneous nuclear RNA, r RNA, t RNA. Alternate transcription and processing on individual genes. Mitochondrial genome and diseases.

Unit II

General homologous recombination. Non-homologous end joining. Site specific recombination, Transposable elements, Mechanism of Transposition. The Lac -operon positive, negative and repression. Arabinose operon. Tryptophan operon. The lambda phase: a complex of operon.

Unit III

Molecular basis of gene mutation. Gain of function mutation. Loss of function mutation and their consequences. Chemical mutagenesis in higher organism. Repair of DNA damage. Photoreactivation. SOS repair mechanism. Base excision repair. Nucleotide excision repair. Stability of the genome.

Unit IV

Population and gene pool. Calculating allele frequencies. The Hardy-Weinberg law. Extension of Hardy -Weinberg law, Natural selection, Mutation, Migration, Genetic drift, Non-random mating. Adaptive radiation and modification, Isolating mechanism, Speciation- Allopatric and Sympatric, Convergent evolution, Sexual selection, Co-evolution.

Recommended Books

1. Introduction to Genetic Analysis. 9th Edition by Griffiths et al. 2008.
2. Concept of Genetics. 9th Edition, by Klug et al. 2009.
3. Principles of Genetics by Snustad et al. 2004.
4. Genes IX Lewin 2008.
5. Molecular Biology of the Gene Watson et al. 6th Edition 2009.
6. Molecular Cell Biology by Lodish et al. 2008
7. Molecular Biology of the Cell Alberts et al. 5th Edition. 2007.

MBM -104

BIOINFORMATICS & BIOSTATISTICS (CBCS)

Unit I

What is Bioinformatics, Biosciences, Emerging areas in Bioinformatics, Future prospects of Bioinformatics, Introduction to Genomics, Introduction to Proteomics, Human Genome Project, Public Database, Gene Bank, Using Public Database? Computer Basics: Computer and its components, Characteristics of computer, Classification of Computers, Hardware: Processor/CPU, Input/Output devices, motherboard slots/cards, bus parallel and serial ports, various storage devices/media, Client-Server concepts, Memory. Software basics: Data vs. information, Software: types of software's, Firmware, Operating system, Programming Languages, Compilers, Interpreters, Ideas of portability and platform dependence, MS-DOS, Windows, UNIX, Linux.

Unit II

DNA and Protein sequence analysis, tools, BLAST, FASTA, Protein Visualization tools, Ras Mol. VMDL, Chime, ORF finder, Gene finder, Gene Scan. Biological databases: Medline EMBL Gene bank, Pub Med, PDB, Entry and retrieval of Data from public databases. Database: Database basics, RDBMS, MS Access, My SWL, ER- Diagram, Relationship. Internet: Computer networking: LAN & WAN, Internet and its application, Major features, WWW and its attributes, web browsers & web server, websites/ address/ pages, Client Server Principles, Protocols and search engines/tools, Bioinformatics resources on internet.

Unit III

Measures of central tendency- average, mean, median, mode, measures of location-percentile, graphic method, Arithmetical method, application and uses of percentiles, Types, biological, real, experimental, measures of variability, range, semi-inter quartile range (Q), mean deviation, standard deviation (SD), and coefficient of variation (CV), Probability: Addition law of probability, multiplication law, binomial probability distribution, Poisson distribution, probability chance from shape of normal distribution or normal curve. Basic introduction to Multivariate statistics.

Unit IV:

Idea of parametric and non parametric statistics, Hypothesis testing (Large and small samples test), types of errors and level of significance, confidence interval, test of significance (F-test & T-test), chi-square test, Significance of difference in proportions of large samples, Correlation and regression, Design and methodology of an experiment or a study: Step and methodology, format for presentation of any research work.

Recommended Books

1. Fundamental Concepts of Bioinformatics Dan E. Krane, Wright State University
Michael L. Raymer, Wright State University
2. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins By Andreas Baxevanis and Francis Ouellette'
3. Bioinformatics: A Biologist's Guide to Biocomputing and the Internet By Stuart Brown
4. All of Statistics: A Concise Course in Statistical Inference by Larry Wasserman

5. Biostatistics: The Bare Essentials Geoffrey R. Norman PhD, David L. Streiner PhD
6. Principles and Practice of Biostatistics B Antonisamy, Prasanna S. Premkumar

MBM -201

BACTERIOLOGY

Unit I

Morphology and ultra structure of bacteria – morphological types- cell walls of archaeobacteria-gram negative – gram positive eubacteria, L-forms- cell wall synthesis, antigenic properties-capsule- types, composition and function, cell membranes- structure – composition – properties.

Unit II

Structure function of flagella –cilia – pili – gas vesicles – chromosomes, carboxysome – magnetosomes and phycobolismes – nucleoid – cell division – spores. Reserve food materials – polyhydroxybutyrate – polyphosphate granules – oil droplets – cyanophycin granules and sulphur inclusions.

Unit III

Cultivation of bacteria – aerobic – anaerobic – shaker –still – nutritional types – culture media used – growth curve –generation time – growth kinetics – asynchronous – synchronous – batch – continuous culture – measurement of growth and factor affecting growth, control of bacteria – physical and chemical agents – preservation methods.

Unit IV

Classification of micro organisms – introduction – Haeckel's three kingdom concept – Whittaker's five kingdom concept – three domain concept of Carl Woese, Basis of microbial classification, Classification and salient feature of bacteria according to the bergey's manual of determinative bacteriology, cyanobacteria, prochlorons and cyanobacteria.

Recommended Books

1. A.J Salle, fundamental Principles of Bacteriology.
2. Brock T.D Madigan M.T Biology of Microorganisms. Prentice Hall inc.
3. Pelczar M.Z Chan E.C.S, Kreig N.R. Microbiology, Mc Graw Hill.

MBM -202

VIROLOGY

Unit I- General Virology

Brief outline on discovery of viruses, nomenclature and classification of viruses; distinctive properties of viruses; morphology & ultra structure; capsids & their arrangements; type of envelopes and their composition-viral genome, their types and structure; virus related agents (viroids, prions). Cultivation of viruses in embryonated eggs, experimental animals, and cell culture; primary & secondary cell culture; suspension cell cultures and monolayer cell culture; cell strains, cell lines.

Unit II- Bacterial and Plant Viruses

Bacteriophage structural organization; life cycle; one step growth curve; transcription; DNA replication; eclipse phase; phage production; burst size; lysogenic cycle; bacteriophage typing; application in bacterial genetics; brief details on M13, Mu, T4, and lambda P1. Assay of viruses – physical and chemical method (protein, nucleic acid, radioactivity tracers, electron microscopy)- infectivity assay (plaque method, end point method).

Unit III

Classification and nomenclature; effects of viruses on plant; appearance of plants; historical, physiology and cytology of plants; common virus diseases of plant; paddy, cotton, tomato, and sugarcane; viruses of cyanobacteria, algae, fungi; life cycle; type species, of plant viruses like TMV, Cauliflower Mosaic Virus and potato Virus X; transmission of plant viruses with vectors (insects, nematodes, fungi) and without vectors (contact, seed and pollens); diagnostic techniques in seeds; seed stocks and diseased plants (seed morphology, seedling, symptomatology, indicator plants, serological methods, histochemical tests and fluorescent microscopy); prevention of crop loss due to virus infection –virus- free planting material; vector control.

Unit VI- Animal Viruses

Classification and nomenclature of animal human viruses; epidemiology, lifecycle, pathogenicity, diagnosis, prevention and treatment of RNA Viruses; Picorna, Orthomyxo, Paramyxo, Toga and other arthropod viruses, Rhabdo, Rota, HIV and other Oncogenic viruses; DNA viruses; Pox, Herpes, Adeno, SV 40; Hepatitis viruses. Viral vaccines (conventional vaccines, genetic recombinant vaccines used in national immunization programmes with examples, newer generation vaccines including DNA Vaccines with examples) interferons, and antiviral drugs.

Recommended Books

1. Morang C and Timbury M.C (1994) medical virology-X- Edition. Churchill Livingstone, London.
2. Dimmock NJ, Primrose SB (1994). Introduction to modern Virology, IV Edition, Blackwell Scientific Publication, Oxford.
3. Conrat HF, Kimball PC and Levy JA (1994) Virology-III Edition Prentice Hall, Engelwood cliff, New Jersey.
4. Methew, RE.,(1992) Functions of Plant virology, Academic Press, San Diego.

5. Topley and Wilson's (1995) Text Book on Principles of Bacteriology, Virology and immunology. Edward Arnold, London.

MBM -203

IMMUNOLOGY

Unit I

Introduction and Overview of the Immune System. Origin of Immunology and its evolution. Infection and immunity. Types of immunity- Innate and acquired, active and passive, humoral and cell mediated. Clonal selection theory.

Organs and cells of the immune system: structure and function. Hematopoiesis. Lymphocyte traffic. Antigens and immunogens. Adjuvants. Requirements for immunogenicity.

Unit II

Structure and function of immunoglobulins. Antibody variants- isotypes, allotypes and idiotypes. Monoclonal antibodies. Hybridoma technology. Organization of immunoglobulin genes. Theories and genetic basis of antibody diversity. Antibody – antigen binding: affinity, avidity, cross reactivity. Antigen-antibody interactions; agglutination, hemagglutination. Precipitation reactions in solution and in gels. Immunoassays: Radioimmunoassay, ELISA, ELISPOT, immunofluorescent assays. Fluorescence activated cell sorting. Western blotting.

Unit III

Major histocompatibility complex. MHC genes and Histocompatibility antigens. Role of MHC in T cell selection. Cytokines and their role in immune regulation. Complement system. Mechanism of its fixation; complement activation and its biological activities. Classical, alternative and lectin pathways; Regulation of complement.

Unit IV

Immunological tolerance to self and to antigens; its induction and features. Immunosuppression- specific and non-specific. Allergy and hypersensitivity. Effector mechanisms and examples of each type of hypersensitivity. Transplantation immunology. Tumor immunology. Immunodeficiencies; primary and secondary. Autoimmunity: factors contributing to autoimmunity; examples and diagnosis. Immunization and Vaccines.

Recommended Books

1. Basic Immunology by Abul Abbas Andrew H. Lichtman and Shiv Pillai, Elsevier
2. Basic immunology by Jacqueline Sharon, Williams & Wilkins
3. Kuby Immunology. W. H. Freeman & Co.
4. Immunology by Ivan Roitt, Jonathan Brostoff, and David Male, Elsevier
5. How the Immune System Works, by Lauren M. Sompayrac, Wiley
6. The Elements of Immunology by Fahim Halim Khan Pearson Education India, 2009

MBM -204

BIOCHEMISTRY (CBCS)

Unit I- Carbohydrate and Lipid Metabolism

Glycolysis, HMP pathway, Glycogenolysis, PDH reaction, Tricarboxylic Acid Cycle: Krebs' discovery, isotopic tests, amphibolic nature, energetics and regulation. Gluconeogenesis, Synthesis of Glycogen and important disaccharides, hormonal regulation of Carbohydrate metabolism.

Oxidation of lipids: beta-oxidation, oxidation of unsaturated and odd chain fatty acids, regulation of Fatty acid oxidation, Formation and oxidation of Ketone bodies. Biosynthesis of saturated fatty acids: carbon sources, acetyl CoA carboxylase and reaction of Fatty acid synthase. Synthesis of odd chain and unsaturated fatty acids. Biosynthesis of Triacylglycerol and phosphoglycerides. Biosynthesis of cholesterol and its regulation.

Unit II- Amino Acid Metabolism Amino acid oxidation

flow sheet, deamination and transamination reactions, alpha- ketoglutarate, succinate, fumarate and oxaloacetate pathways of amino acid oxidation. Metabolic fates of amino groups, role of glutamate and glutamine. Urea Cycle: reaction and regulation, Biosynthesis of standard essential and non-essential amino acids. Regulation of amino acid biosynthesis. Genetic defects in amino acid metabolism.

Unit III- Nucleotide and Heme Metabolism

Degradation of purine & pyrimidine ribonucleotides and its regulation. Biosynthesis of purine & pyrimidine 4 ribonucleotides: de-novo pathways and salvage. Reactions and regulation of ribonucleotide reductase and thymidylate synthase, purine nucleotide cycle. Genetic defects, in nucleotide metabolism. Enzymes of Nucleotide metabolism as chemotherapeutic targets. Heme biosynthesis and degradation.

Unit IV- Enzymology

Enzyme catalysis: Acid-Base, metal ion, covalent and electrostatic catalysis, Reaction coordinates. Transition state stabilization and entropy reduction by enzymes. Enzyme kinetics: Substrate velocity curve, MichaelisMenten mechanism for single substrate reactions, Meaning and significance of Km, Ks, Kcat and specificity constant. Lineweaver-Burk and Eadie-Hofstee plots, kinetics of bisubstrate reactions. Enzyme Inhibition: Mechanism and kinetics of competitive, uncompetetive, mixed and noncompetitive inhibitions.

Recommended Books

1. Nelson, David L., Albert L. Lehninger, and Michael M. Cox. Lehninger principles of biochemistry. Macmillan, 2008. Berg, Jeremy M., John L. Tymoczko, and Lubert Stryer. "Biochemistry 5th ed." (2002).
2. Voet, Donald, Judith G. Voet, and Charlotte W. Pratt. Fundamentals of Biochemistry 2002 Update. John Wiley & Sons, 2002.

MBM -205

RECOMBINANT DNA TECHNOLOGY (SEC)

Unit I

History of recombinant technology, restriction modification system in bacteria, DNA modifying enzymes and their mechanisms of action, functions of adapters, linkers and homopolymer linking in molecular cloning, purification of DNA from living cells, construction of genomic and cDNA libraries, screening of libraries, substrate hybridization for tissue specific DNA libraries

Unit II

Expression of foreign genes in E. coli, production of recombinant protein by prokaryotic expression vectors, eukaryotic expression vectors, mammalian expression vectors; fusion tags, role in purification of recombinant proteins, detection of expressed proteins

Unit III

Chemical synthesis of DNA, changing gene: Random and site-directed mutagenesis, strategies for gene transfer to animal cells, genetic manipulation of mammals, genetic transformation of plant cells - biolistics and Agrobacterium mediated, next generation and advanced sequencing, pyrosequencing, recent advances in protein engineering and metabolic engineering

Unit IV

Nucleic acid sequences as diagnostic tools, new drugs and new therapies for genetic diseases, gene therapy for genetic diseases, production of recombinant pharmaceuticals, hormones, recombinant vaccines, antisense therapy, gene knockout

Recommended Books

1. Singh BD (2010) Biotechnology 4 th Edition, Kalyani Publications
2. Nair AJ (2008) Introduction to Genetic Engineering and Biotechnology. Infinity Science Press
3. Brown T (2010) Gene cloning and DNA analysis: an introduction. John Wiley & Sons

MBM -301

MICROBIAL DIVERSITY

Unit I

Introduction to microbial diversity – distribution – abundance – ecological niche. Oxygenic photosynthetic microbes – anoxygenic photosynthetic microbes – Oxidative transformation of metals – sulphur oxidation, iron oxidation and hydrogen oxidation. Unculturable and culturable – conventional and molecular method of studying microbial diversity. Classification of prokaryotes, fungi and algae.

Unit II

Ecosystems, habitats, symbiosis, mutualism, parasitism, commensalism and antagonism. Microbial diversity in anoxic ecosystem – methanogens – reduction of carbon monoxide – reduction of iron, sulphur, manganese, nitrate and oxygen – microbes and mechanisms of metal reduction – bioleaching of ore metal corrosion. Microbial transformation of carbon, phosphorus, sulphur, nitrogen and mercury.

Unit III

Extremophiles – acidophilic, alkalophilic thermophilic, barophilic and osmophilic microbes – mechanisms and adoption. Halophiles – membrane – variation – electron transport – application of thermophiles and extremophiles.

Unit IV

Subterranean microbes – ground water contamination and microbial transformation. Biomagnification, bioaccumulation and bioremediation. catabolic of recalcitrant molecule degradation and mineralization.

Recommended Books

1. Johri, B.N 2000. Extermophlies. Springer Veriag. New York
2. Colwd, D.1999. Microbial Diversity. Aademic Press
3. Introduction to Microbiology and Microbial Diversity Paperback – 2018 by by Dr. Prasanna V Dharani Aiyer (Author)

MBM -302

EUKARYOTIC MICROBIOLOGY

Unit I

An introduction to Fungi: General features of Fungi, Classification of Fungi, Life cycle of selected Fungi (*Aspergillus*, *Penicillium*, Yeast). Structure of Fungal cells. Hyphae and non motile unicells, motile cells, spores, dormancy, growth of population and colonies, effect of environment on growth, prevention of fungal growth.

Unit II

Fungi and ecosystem: Saprophyte, substrate groups and nutritional strategies, substrate successions, fungi and bioremediation, parasitism, mutualism and symbiosis with plants and animals, attack on fungi by other microorganisms.

Unit III

Protozoans characteristics, classifications and general account. Pathogenic protozoans and parasitism in protozoans. Ultra structure and life cycle of Plasmodium in invertebrate and vertebrate hosts.. Comparative account of various human species of Malaria pathogens, symptom, treatment and control.

Unit IV

Trypanosoma: Structure and Life cycle, polymorphism in human and invertebrates host pathogens and therapy, *Leishmania*, systematic position, morphology, kala-azar, symptoms and pathogen *Entamoeba histolytica* as monogen parasite, pathogenesis, host parasite interactions.

Recommended Books

1. Rumen Microbiology: From Evolution to Revolution 1st ed. 2015 Edition, Kindle Edition
by Anil Kumar Puniya (Editor), Rameshwar Singh (Editor), Devki Nandan Kamra (Editor)
2. Textbook of Medical Parasitology : Protozoology & Helminthology, 4th Edition Paperback – 2013 by Subhash Chandra Parija (Author)
3. Elementary Bacteriology and Protozoology 19 May 2016 | Import by Herbert Fox
4. Invertebrate Zoology Paperback – 2006 by Robert D. Barnes (Author)
5. An Introduction to Fungi: 4th Edition Paperback – 2012 by H C Dube (Author)
6. Fungi and Allied Microbes Paperback – 1 Jul 2017 by O P Sharma (Author)
7. Introductory Mycology, 4ed Paperback – 2007 by C.J. Alexopoulos (Author), C.W. Mims (Author), M. Blackwell (Author)

MBM -303

MEDICAL MICROBIOLOGY

Unit I

Early discovery of pathogenic microorganisms; development of bacteriology as a scientific discipline; contribution made by eminent scientists. Classification of medically important flora and the organisms; Normal microbial flora of human body; role of the resident flora; normal flora and the human host.

Unit II

Establishment, spreading, tissue damage and anti – phagocytic factor; mechanism of bacterial adhesion, colonization and invasion of mucous membranes of respiratory, enteric and urogenital tracts. Role of aggressions, depolymerising enzymes, organotropisms, variation and virulence. Organs and cell involved immune system and immune response.

Unit III

Classification of pathogenic bacteria. Staphylococcus, Streptococcus, Pneumococcus, Neisseria, Cornebacterium Bacillus, Clostridium, Non sporing Anaerobes, Organisms belonging to Enterobacteriaceae, Vibrios, Non fermenting gram negative bacilli Yersinia, Haemophilus; Bordetella, Brucella; Mycobacteria, Spirochates, Anctiomycetes; Rickettsiae, Chlamdiae. common types of hospital infection and their diagnosis and control.

Unit IV

General properties of viruses; viruses Host interaction; Pox viruses; Herpes virus, Adeno viruses; picarno viruses; Picarno Viruses; Orthomyxo viruses; Paramyxo viruses; Arboviruses, Rahbdo viruses, Hepatitis viruses; opportunistic fungal pathogens. Description and classification of pathogenic fungi and their laboratory diagnosis.

Recommended Books

1. Text of Microbiology , R. Anathanaryanan and C.K Jayaram Panicker, Orient Longman,1997.
2. Mackie and McCartney Medical Microbiology Vol.1: Microbial infection.Vol.2: Practical Medical MicrobiologyChurchill Lvinggdton,1996.
3. Microbiology in clinical Practice.D.C Shanson, Wright PSG,1982.
4. Bailey and Scott's Diagnostic MicrobiologyBaron EJ, Petersone LR and Finegold SM Mosby,1990.

MBM -304

ENVIRONMENTAL WASTE MANAGEMENT (CBCS)

Unit I

Introduction to environmental waste and environment protection. Biopesticides: *Bacillus thuringiensis*, Baculo and begomoviruses viruses, Neem, green manuring, Phosphate solubilizing organisms. Biofertilizer: Algal, cyanobacterial and bacterial biofertilizers. Bioplastics.

Unit II

Water as a scarce natural resource, water management including rain water harvesting; Potability of water, microbial assessment of water; Municipal wastes - sewage and effluent, waste water characteristics, waste water treatment – physical, chemical and biological processes; Aerobic processes – activated sludge, oxidation ditches, trickling filters, oxidation ponds; Anaerobic processes – anaerobic digestion, anaerobic filters, anaerobic sludge, membrane bioreactors; Treatment of industrial effluents - dairy, distillery, tannery, textile, paper and sugar industries, CETP, Reverse osmosis and ultrafiltration. Sewage treatment plant.

Unit III

Waste types: Solid and liquid waste, characterization of solid and liquid waste. Waste treatment: Physical, chemical, biological; aerobic, anaerobic; Primary, secondary, tertiary; Solid waste treatment- Saccharification, gasification, composting; Utilization of solid waste - food (SCP, mushroom, Yeasts), fuel (ethanol, methanol), fertilizers (composting). Biomedical waste management and disposal

Unit IV

Bioremediation: Concept and principles, microbial bioremediation, *in situ* and *ex situ* bioremediation; Biosorption and bioaccumulation of heavy metals, phytoremediation; Bioremediation of xenobiotics (heavy metals, pesticides, oil slicks, plastics), soil and water contaminated with hydrocarbons and surfactants, biofilms, xenobiotic compounds and their sources, biomagnifications.

Recommended Books

1. Microbial ecology by Alexander M (1971): John Wiley and sons Inc., New York.
2. Introduction to Biodeterioration by Allsopp D and K.J. Seal., (1999): Edward Arnold Publication, London.
3. Manual of Environmental Microbiology by Christson J Harst, (1997): ASM press Washington D.C. Washington.
4. Environmental Microbiology by Hurst, C.J, (1988) : ASM Press, NJ, USA.
5. Bioremediation by Baker K H and Herson D S : Mc GrawHill , New Delhi.

MBM -305

FOOD MICROBIOLOGY

Unit I

Food as substrate for microorganisms: Micro organisms important in food microbiology – Molds, Yeasts and Bacteria-General characteristics-classification and importance. Principles of food preservation. Asepsis – Removal of microorganisms,(anaerobic condition, high temperatures, low temperatures, drying,). Factor Influencing microbial growth in food – Extrinsic and intrinsic factor; Chemical preservatives and Food additives. Canning, processing for Heat treatment-D, Z and values and working out treatment parameters.

Unit II

Food –borne infection and intoxications: Bacterial and nonbacterial- with examples of infective and toxic types- Brucella, Bacillus, Clostridium, Escherichia, Salmonella, Shigella, Staphylococcus, Vibrio, Yersinia; Nematodes, protozoa, algae, fungi and viruses. Foodborne outbreaks laboratory testing procedures; Prevention Measures- Food sanitation in manufacture and retail trade; Food control agencies and its regulations, Plant sanitation-Employee's Health standards –waste treatment- disposal – quality control.

Unit III

Contamination and spoilage: cereals sugar products, vegetables, fruits, meat and meat products, Milk products- Fish and sea foods-poultry- spoilage of Canned food. Detection of spoilage and characterization.Food fermentations: bread, cheese, vinegar, fermented vegetables, fermented dairy products; Experimental and industrial production method. Spoilage and defects of fermented dairy products – oriental Fermented food, their quality standards and control.

Unit IV

Food produced by Microbes: Fermented food, microbial cells as food (single cell proteins) – mushroom cultivation. Bioconversions - production of alcohol –Fermented beverages – beer and wine. Steriod conversion – industrial Enzymes production – amylases, proteinases, cellulases; Aminoacid production – glutamic acid and lysine productions. Genetically modified food.

Recommended Books

1. Adams M.R and Moss M.O (1995) food microbiology. Royal Society of Chemistry Publication, Cambridge.
2. Frazier WC and Westhoff Dc (1988). Food Microbiology. Tata McGraw Hill Publishing Company Ltd, New Delhi.
3. Stanbury, PF., Whiteker, and Hall, S.J (1995) principles of Fermented Technology. 2nd Edition. Programme Press.
4. Banwart, GJ (1989) Basic Food Microbiology. CBS Publishers and Distributors, Delhi.
5. Hobbs BC and Roberts D. (1993) Food poisoning and Food Hygiene. Edward Arnold (A division of Hodder and Stoughton) London.
6. Robinson RK (1990) Dairy Microbiology. Elsevier Applied Sciences, London.

MBM -401
TECHNICAL WRITING & SEMINAR (AECC)

In presence of the supervisor

MBM -402
PROJECT & DISSERTATION

In presence of the supervisor

MBM -403
FERMENTATION TECHNOLOGY (CBCS)

Unit I

General Consideration method pathways and metabolic control mechanisms primary and secondary metabolites.

Unit II

Fermentation in batch culture microbial growth kinetics; measurement of growth (cell number, direct and indirect method) growth and nutrient growth and product formation; heat evolution; effect of environment (temperature, pH, High nutrient concentration) media formulation. Sterilization; kinetics of thermal death of micro organisms; batch continuous sterilization.

Unit III

Continuous Culture: Continuous culture system; productivity product formation. Aeration and agitation; power requirement oxygen transfer kinetics; concepts of Newtonian and Non - Newtonian fluids, plastics fluids apparent foam and antifoam.

Unit IV

Scale-up; instrumentation control; physical and chemical environment sensors; downstream process.

Recommended Books

1. Stanbory P.F.A Whitaker Hall. 1985. Principle of Fermentation Technology Pergaman McNeul Harvey.1990.
2. Fermentation A. Practical Approach IRL.
3. Basic Fermentation Technology1 January 2017 by S.M. Reddy