D.N.R COLLEGE, BHIMAVARAM

DEPARTMENT OF MICROBIOLOGY (P.G.)

Following are the papers of 1st semester for the years 2013-14, 2014-15 & 2015-16

MB 101: GENERAL MICROBIOLOGY

UNIT – I:

History, discovery, evolution, development and recent trends in Microbiology. Contributions of Van Leeuwenhock, Joseph Lister, Pasteur, Koch, Jenner, Winogradsky and Beijerinck.Nobel laureates in Microbiology.

Distinguishing characteristics between prokaryotic and eukaryotic cells.Structure and function of cell wall of bacteria, cell membranes, flagella, pili, capsule, gas vesicles, carboxysomes, magnetosomes and phycobolisomes.

Concepts, nomenclature and taxonomic ranks.general properties of bacterial groups. Major characteristics used in Taxonomy-morphological, nutritional(cultural), chemical, biochemical, physiological, metabolic, ecological, immunological, pathogenic properties. C

Identification, characterization and classification of microorganisms- Principles of bacterial taxonomy and classification: - Bergey's manual and its importance, concept of kingdom - Haeckel's three kingdom concept-Whittaker's five kingdom concept-three domain concept of Carl Woese.

UNIT- II:

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.

Chemical structure of peptidoglycon, protoplasts, spheroplasts, microsomes and ribosomal RNAs, Nuclear material/nucleus.

Microscopic identification, characteristics, staining methods – simple staining, differential staining, structural staining and special staining methods.

Microbiological media-Natural and synthetic; autotrophic, heterotrophic and phototropic and prototrophic media: basal, defined, complex, enrichment, selective, differential, maintenance and transport media.

Preservation and Maintenance of Microbial cultures: Repeated sub culturing, preservation at low temperature, sterile soil preservation, mineral oil preservation, deep freezing and liquid nitrogen (cryo) preservation, drying, glycerol cultures, freeze-drying (lyophilization). Advantages and disadvantages of each method

UNIT –III

Types of cultures- stock, batch, continuous and synchronous cultures. Growth measurement methods –Direct methods: viable plate counts, membrane filtration, microscopic counts, electronic counters, most probable number; Indirect methods: metabolic activity (measurements of NAD, ATP, DNA, and Protein, CO_2 liberated O_2 consumed, extra cellular enzymes), dry weight, turbidity. Cultivation of aerobes and anaerobes. Reproduction in bacteria and spore formation.

Morphology, Ultra structure and chemical composition of bacteria, Actinomycetes, Spirochetes, Rickettsiae, Mycoplasma, Chlamydiae – TRIC agents and LGV, Cyanobacteria, Archaebacteria

UNIT- IV

Eukaryotic microorganisms: General characteristics, reproduction and economic importance of fungi. Classification, structure, composition, reproduction and other characteristics of fungal divisions-Zygomycota, Ascomycota, Basidomycota, Deuteromycota and slime & water molds

Structure, reproduction and other characteristics of algal divisions, Distribution of algae.Classification of algae by Fritsch.Characteristics of - dinoflagellates, thallus organization, products of algae and their economic importance. Algal SCP, emphasis on *Spirulina.*

Characteristics of Various protozoa-Morphology, nutritional requirements, reproduction.morphology, Life cycle and Pathology of *Entamoeba histolytica, Plasmodium,* Free Living Pathogenic Amoeba *Naglaria&Acanthamoeba.*

MB 102: VIROLOGY

UNIT–I:

History and Discovery of Viruses, Nature, origin and evolution of viruses, New emergingand re-emerging viruses, viruses in human welfare.

Properties of Viruses- Biological properties of viruses – host range, transmission-vector,non-vector; Physical properties of viruses – morphology, structure, sedimentation, electrophoretic mobility, buoyant density; Biochemical characteristics – chemical composition of viruses, proteins, nucleic acids, envelope, enzymes, lipids, carbohydrates, polyamines, cations, Antigenic nature of viruses.

Isolation, cultivation, assay and maintenances of viruses – Animal, Plant and Bacterial Viruses: biassay tissue culture – organ culture, primary and secondary cell cultures, suspension and monolayer cell cultures, cell strains, cell lines, embryonated eggs; experimental plant tissue cultures.

UNIT-II:

Nomenclature, classification and structure of viruses – criteria used for naming, classification of viruses, recent ICTV classification of viruses infecting animals, humans, plants, bacteria, algae, fungi. Major characteristics of different virus families/genera/groups-Poxviridae, Hepadnaviridae, Baculoviridae, Adenoviridae, Herpesviridae, Ortho and Paramyxoviridae, Retroviridae, Reoviridae, Parvoviridae, Rhadboviridae, Picornaviridae, Flaviviridae, Potyviridae, Tobamoviridae, Bromoviridae, Bunyaviridae, Geminiviridae, Caulimoviridae.

Algal, Fungal and Bacterial viruses- Phycodnaviridae, Cyanophages, Partitiviridae and Totiviridae. Subviral agents-sat viruses, Sat nucleic acids, Viroids, Prions.

UNIT – III:

Viral replication and genome expression – viral genomes- structure and complexity of viral genomes, diversity among viral genomes – DNA and RNA genomes- linear, circular, double and single stranded; positive and negative sense of RNA genomes, mono, bi, tri and multipartite of genomes. Replication of viruses – an overview of viral replication cycles, replication strategies of DNA, RNA viruses and regulation of viral genome expression-Baltimore strategies.

Virus – host interactions – cytopathic effects of viral infections, inclusion bodies, chromosomal aberrations; Response of host cells to viral infection –interference, immunological responses of the host.

UNIT – IV:

Transmission of viruses – Vertical (Direct) transmission – contact, mechanical,transplacental, transovarial, sexual, fecal, oral, respiratory, seed and pollen. Horizontal (Indirect) transmission-

aerosols, fomites, water, food, graft, dodder. Vector-arthropod, non-arthopods, virus and vector relationship.Multiple host infections – viral zoonosis.
Diagnosis of viral diseases – clinical symptoms, immuno diagnosis, molecular methods used in viral diagnosis, prevention and control of viral diseases, sanitation, vector control, vaccines and immunization control – chemoprophylaxis, chemotherapy – anti viral drugs,interferon therapy, efficacy of infection control.

MB 103: BIOMOLECULES

UNIT – I:
Major Biomolecules: Carbohydrates – Classification, chemistry, properties, and function– mono, di, oligo and polysaccharides. Conjugated polysaccharides– glycoproteins, mureins and lipopolysaccharides.
Lipids – classification, chemistry, properties and function – free fatty acids, triglycerides,phospholipids, glycolipids & waxes. Conjugated lipids – lipoproteins. Major steroids of biological importance – prostaglandins.

UNIT –II:
Amino acids and proteins – classification, structure and function.Essential amino acids &amphoteric nature of amino acids and reactions and functions of carboxyl and amino groups andsidechains.Peptidestructure.Ramachandran'splot.Methods for isolation and characterizationof proteins. Structural levels of proteins – primary, secondary, tertiary and quaternary,denaturation of proteins. Hydrolysis of proteins.Protein sequencing using various methods.

UNIT – III:
Nucleic acids – structure, function and their properties.Structural polymorphism of DNA, RNA.Structural characteristics of RNA.
Sources, Chemistry and biochemical functions of water-soluble vitamins.
Chemistry of Porphyrins – Heme, Cytochromes, Chlorophylls, xanthophylls, Bacteriochlorophylls& algal pigments, Carotenoides.

UNIT-IV:
Biological oxidation, Biological redox carriers, biological membranes, electron transport ,oxidative phosphorylation and mechanism.
Mineral metabolism – phosphorus, potassium, calcium and Trace elements –molybdenum, zinc, manganese, cobalt and copper. Influence of minerals on the production of toxins. Role of trace elements on microbial enzymes.

MB 104: ANALYTICAL TECHNIQUES

UNIT – I:
Microscopy – Principles of light, phase, fluorescent & electron microscopes; Microtomy– sectioning. Microscopic techniques: Basic principles and applications of phase – contrastmicroscopy (phase annulus, phase plate, specimen preparations), fluorescent microscopy (filters,dark field condensor, complex optical system, sample preparations) and electron microscopy(Magnetic lenses, electron beams, condensors, types of electron microscopy – scanning andtransmission, sample preparations - fixing of specimens, preparation of blocks, microtomyandstaining, negative staining techniques of biological samples), cytometry and flow cytometry.

UNIT – II:

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. Immunoelectrophoresis. Immunoblotting. Isoelectric focusing, 2-D electrophoresis

UNIT – III:
Principles, Laws of absorption and radiation.Visible, ultraviolet, infrared and mass spectrophotometry. Absorption spectra, fluorescence flame photometry, NMR, ESR, Principles of colorimetry, Turbidometry, Viscometry. Determination of size, shape and molecular weight ofmacromolecules – osmotic pressure, flow birefringence, optical rotatory dispersion.Lightscattering, diffusion, sedimentation and X-ray diffraction.

UNIT-IV:
Radio isotopic tracers – methodology, problems of experimental design, radiometricanalysis, stable and radioactive isotopes, preparation, labeling, detection and measurement of isotopes.RIA.Kinetics of radioactive disintegration.Manometric techniques.

Following are the papers of 1st semester for the years 2016-17, 2017-18 & 2018-19

MB101 GENERAL MICROBIOLOGY

Unit I:

Discovery, Evolution and development of Microbiology**;** Contributions of Van Leeuwenhock, Joseph Lister, Pasteur, Koch, Jenner, Winogradsky, Beijerinck; Identification, characterization and classification of microorganisms; Bergy's manual, Hackel's three kingdom concept, Whittaker's five kingdom concept, three domain concept of Carl Woese; Major characteristics used in Taxonomy; the kingdoms of organisms and phylogenetic trees - Distinguishing characteristics between prokaryotic and eukaryotic cells; Structure and function of cell organelles of microorganisms.

Unit II:

Methods of sterilization- Physical methods, chemical methods and their application; Microbial cultures- pure culture isolation, Enrichment culturing techniques, single cell isolation, and pure culture development; Chemical structure of peptidoglycan, protoplasts, spheroplasts, microsomes and ribosomal RNAs, Microscopic identification characteristics, staining methods; Growth media and types; Preservation and maintenance of Microbial cultures.

Unit III:

Ecological identification methods; Bacterial nutrition and growth kinetics - synchronous, stock, batch and continuous cultures; Growth measurement methods – Metabolic diversity; Cultivation of aerobes and anaerobes; Reproduction in bacteria & spore formation;

Morphology, Ultra structure and chemical composition of bacteria, actinomycetes, spirochetes, rickettsiae, mycoplasma, Chlamydiae – TRIC agents and LGV Archaebacteria.

Unit IV:

General characteristics, reproduction and economic importance of fungi; Classification, structure, composition, reproduction and other characteristics of fungal divisions; Structure, reproduction and characteristics of algal divisions, Distribution of algae; Classification of algae by Fritsch; Characteristics of blue green algae, dinoflagellates, thallus organization, products of algae and their economic importance; emphasis on Spirulina; Characteristics, morphology, reproduction, lifecycle and pathology of protozoans.

MB102 BACTERIOLOGY AND VIROLOGY

Unit I:

Biology of bacteria: Staphylococcus, streptococcus, Pneumococcus, Nesseria, Corynebacterium; Bacillus, Clostridium, Proteus, Shigella, Salmonella, Vibrio, Pseudomonas, Yersinia, Haemophilus, Bordetella, Brucella, Mycobacterium, Spirochetes, Mycoplasmas, rickettsiae and chlamydiae.

Bacterial growth- Measuring bacterial growth- Spectrophotometric method, microscopic counting, serial dilution and viable cell count, MPN, and filtration technique; Bacterial reproduction-fission, budding and endospore formation

Unit II:

Economic importance of bacteria: A brief account on the economic importance of bacteria in Agriculture- Nitrogen fixing organisms; ecological importance-bioremediation and biopesticides; Industrial importance- source of antibiotics, production of recombinant proteins- growth factors, hormones, vaccines etc.; Normal flora in the GIT and their advantages.

Antibacterial agents: Mode of action of antibiotics and chemotherapeutic drugs; Antibiograms; Antibiotic sensitivity assays- disc method; replica plating technique; Ames test; Antibiotic resistance in bacteria- various factors that contribute to the development of resistance, Bacterial quorum sensing, Biofilms.

Unit III:

Concept and scope of virology:

History and Discovery of Viruses, Nature, origin and evolution of viruses, New emerging and re-emerging, viruses, Nomenclature, classification and structure of viruses, recent ICTV classification of viruses infecting animals, humans, plants, bacteria, algae, fungi; Major characteristics of different virus families/genera/groups; Properties of Viruses, chemical composition of viruses; Biological properties of viruses – host range, transmission-vector, non-vector; Isolation, cultivation, assay and maintenances of viruses; Viruses culture – organ culture, primary and secondary cell cultures, suspension and monolayer cell cultures, cell strains, cell lines, embryonated eggs.

Unit IV:

Viral genome and transmission:

Structure and complexity of viral genomes, diversity among viral genomes – DNA and RNA genomes, positive and negative sense of RNA genomes; Replication of viruses – replication strategies of DNA, RNA viruses and regulation of viral genome expression. Transmission of viruses – Vertical (Direct) transmission, Horizontal (Indirect) transmission Vector-arthropod, non-arthropods, virus and vector relationship; Diagnosis of viral diseases, prevention and control of viruses, vaccines and immunization, chemoprophylaxis, chemotherapy, interferon therapy.

MB103 - BIOMOLECULES

Unit I:

Carbohydrates – Classification, chemistry, properties, and function – mono, di, oligo and polysaccharides; bacterial cell wall polysaccharides; Conjugated polysaccharides– glycoproteins and lipopolysaccharides; Lipids – classification, chemistry, properties and function – free fatty acids, triglycerides, phospholipids, glycolipids & waxes; Conjugated lipids – lipoproteins; Major steroids of biological importance – prostaglandins.

Unit II:

Amino acids and proteins – classification, structure and function; Essential amino acids & amphoteric nature of amino acids and reactions and functions of carboxyl and amino groups and side chains; Peptide structure; Ramachandran's plot; Methods for isolation and characterization of proteins; Structural levels of proteins – primary, secondary, tertiary and quaternary, denaturation of proteins; Hydrolysis of proteins; Protein sequencing using various methods.

Unit III:

Nucleic acids **–** structure**,** function and their properties; Structural polymorphism of DNA, RNA; Structural characteristics of RNA; Vitamins – Sources, Chemistry and biochemical functions of water-soluble and fat soluble vitamins; Chemistry of Porphyrins – Heme, Cytochromes, Chlorophylls, xanthophylls, Bacteriochlorophylls & algal pigments, Carotenoides.

Unit IV:

Biological oxidation, Biological redox carriers, biological membranes, electron transport, oxidative phosphorylation and mechanism; Bacterial photosynthesis, photosynthetic electron Transport; Mineral metabolism – phosphorus, potassium, calcium and Trace elements – molybdenum, zinc, manganese, cobalt and copper; Influence of minerals on the production of toxins; Role of trace elements on microbial enzymes**.**

MB104 - ANALYTICAL TECHNIQUES

Unit I:

Microscopy – Principles of light, phase, fluorescent & electron microscopes; Microtomy – sectioning; Microscopic techniques- Basic principles and applications of phase – contrast microscopy, fluorescent microscopy and electron microscopy, types of electron microscopy – scanning and transmission, sample preparations - fixing of specimens, preparation of blocks, microtomy and staining, negative staining techniques of biological samples, cytometry and flow cytometry; Principles of Centrifugation – Centrifugation techniques- preparative and analytical methods, density gradient centrifugation.

Unit II:

General principles and applications of chromatography – Paper, Column, Thin layer, Gas, Ion exchange, Affinity chromatography, HPLC, FPLC and Gel filtration; Electrophoresis – moving boundary, zone (Paper Gel) electrophoresis; Immunoelectrophoresis; Immunoblotting; Isoelectric focusing, 2-D electrophoresis

Unit III:

Laws of absorption and radiation; Principles, instrumentation and applications of Visible, ultraviolet, infrared and mass spectrophotometry; Absorption spectra, fluorescence flame photometry, NMR, ESR, Principles of colorimetry, Turbidometry, Viscometry; Determination of size, shape and molecular weight of macromolecules – osmotic pressure, flow birefringence, optical rotatory dispersion; Light scattering, diffusion, sedimentation and X-ray diffraction.

Unit IV:

Radio isotopic tracers – methodology, problems of experimental design, radiometric analysis, stable and radioactive isotopes, preparation, labeling, detection and measurement of isotopes; RIA; Kinetics of radioactive disintegration; Manometric techniques; Freeze drying and its application in biological systems.

Following are the papers of 2nd semester for the years 2013-14, 2014-15 & 2015-16

MB 201: MICROBIAL PHYSIOLOGY & METABOLISM

UNIT– I:

Nutritional types –Autotrophy, heterotrophy and prototrophy. Autotrophic bacteria, chemosynthetic and photosynthetic microorganisms. Heterotrophic bacteria – saprophytes, parasites and mixotrophs. Respiration in bacteria – aerobic and anaerobic types of respiration, obligate aerobes, facultative anaerobes and obligate anaerobes. Toxic effect of oxygen on anaerobes. Bioluminescence in microorganisms. Energy yields. Physiology and biochemistry of sporulation and germination of spores

UNIT-II:

Carbohydrate metabolism in microbes- synthesis of carbohydrates in photosynthetic, chemosynthetic and heterotrophic microbes. Fermentation of carbohydrates by microorganisms –
Embden-Meyerhof-Parnas (EMP) pathway, Entner-Doudoroff (ED) pathway, C2-C4 split pathway. Kreb's cycle, glyoxylate cycle, hexose monophosphate (HMP) shunt, gluconeogenesis,
anaplerotic reactions, synthesis of peptidoglycans and glycoproteins. Anaerobic respiration –
Fermentation, Biochemical mechanisms of lactic acid, ethanol, butanol and citric acid
fermentations. Nitrate and sulphate respiration.

UNIT-III:

Metabolism of amino acids –Biosynthesis of amino acids and their regulation with emphasis on tryptophan and histidine by microorganisms. Protein metabolism - Assimilation of inorganic nitrogen and sulphur, Biochemistry of nitrogen fixation. Urea cycle . Signal transduction with reference to nitrogen metabolism. Catabolism of amino acids, transamination, decarboxylation and oxidative deamination. Porphyrin biosynthesis and catabolism.

UNIT –IV:

Lipid metabolism - Biosynthesis of triacyl glycerols, phospholipids and sphingolipids.
Oxidation of saturated and unsaturated fatty acids. Microbial metabolism of aromatic and
aliphatic hydrocarbons (camphor, 2,4-D and toluene) with emphasis on the role of
monooxygenase and dioxygenase in the ring cleavage (*ortho*, *meta* and gentsiate cleavage) and
reductive catabolism.
Nucleotide metabolism - Biosynthesis of purnine and pyrimidine nucleotides, biosynthesis of deoxyribonucleotides. Regulation of nucleotide synthesis, catabolism of purine and pyrimidines. Secondary metabolism - Utilization of secondary metabolites for production of vitamins, toxins (aflatoxin and corynebacterial), hormones (GA), and antibiotics (penicillin and streptomycin).

MB 202: CELL BIOLOGY & ENZYMOLOGY

UNIT-I:
Organellar Biology: Structure, function & biogenesis of chloroplast and mitochondria, mesosomes, lysosomes and cytoskeletal system. Photosynthesis in bacteria and plants: Organization, apparatus, electron donors & acceptors, energetics.
Physico-chemical properties of bacteria – intracellular osmotic pressure, permeability of the bacterial cell. Nutrient transport – simple diffusion, passive, facilitated diffusion and active. Purple green photosynthetic bacteria
Photosynthesis - Oxygenic and anoxygenic photosynthesis, structure of synthetic pigments, primary photochemistry of PS I and PS II, and photosynthetic electron transport, Carbon dioxide fixation, halo bacterial photosynthesis.

UNIT-II:
Signal transduction in eukaryotes: Protein kinases, phosphorylation cascades, Ras pathway, MAP kinase pathway, Secondry messengers, Cyclic nucleotides, G proteins. Coated vesicles, membrane receptors.

UNIT-III:
Outlines of enzyme classification, nomenclature, assay of enzymes and kinetics of enzyme catalyzed reactions – Michaelis – Menton equation, determination of Km, Vmax and kcat values.
Enzyme inhibitors, competitive, uncompetitive and noncompetitive inhibition. Factors affecting enzyme reaction – pH, temperature, radiation, enzyme and substrate concentrations, activators, coenzymes and metalloenzymes. Ribozymes and abzymes

UNIT-IV:
Active site determination. Mechanism of action of ribonuclease, lysozyme and chymotrypsin. Isoenzymes, Regulatory enzymes – covalent modification, zymogen activation, Allosteric enzymes – ATCase, Glutamine synthetase. Hemoglobin & Myoglobin.
Enzyme purification - Methods of isolation, purification. Recovery and yield of enzymes.
Criteria for testing purity of enzyme preparations. Immobilized enzymes - Methods of Immobilisation. Comparison of kinetics of immobilized and free enzymes. Application of Immobilized enzymes.

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MB 203: MOLECULAR & MICROBIAL GENETICS

UNIT-I:
Molecular organization of chromosomes in Prokaryotes and Eukaryotes. Centromeres and telomeres. Recombination at molecular level, heteroduplex analysis. Fine Structure analysis.
Organisation of genomes – Repeated sequences - C value – cot curves; Multigene families; Molecular markers(RFLP and RAPD). Polymorphisms. Yeast & Drosophila as model organisms. Complementation test and functional allelism.

UNIT-II:
Plasmids – types, plasmid DNA properties. Sex plasmid F and its derivatives, drug resistance (R) plasmids. The Ti plasmid of *Agrobacterium*. Hybridization in yeast, control of mating type loci in yeast. Transposable elements – transposition. Types of bacterial transposons, duplication of target sequence at an insertion site. Deletion and inversion caused by transposons. Transposable elements in yeast and drosophila. Retroposons.

UNIT-III:
Mutations – Terminology, types of mutations, Molecular basis of mutations, isolation & analysis of mutants. Mutagenesis – base analogue mutagens, chemical mutagens, intercalating substances, mutator genes. Site directed mutagenesis, mutational hot spots, Reversion, second site revertants, frame shift mutations, screening of mutants. UV damage of DNA and repair.

UNIT-IV:
Bacterial genetics – Inheritance of characteristics and variability. Phenotypic changes due to environmental alterations. Genotypic changes. Bacterial recombination. Bacterial transformation, Bacterial conjugation, Transduction – Generalized and specialized transductions. Tetrad analysis in eukaryotic microbes – Neurospora and yeast.
Mapping of bacterial chromosome by interrupted mating and transduction. Recombination in bacteriophages. Benzer's studies on r-II locus of T4 bacteriophage.

MB 204: IMMUNOLOGY

UNIT-I:
History and scope of Immunology, Cells involved in immune system – T-lymphocytes, Blymphocytes, monocytes, macrophages, APC, Neutrophils, mast cells. Types of immunity -
Adaptive immunity, innate immunity. Lymphoid organs, Thymus, bone marrow, spleen, lymph nodes. Nature of antigens; antibody structure, classification of antibodies, functions of IgG, IgA, IgM, IgD and IgE; primary and secondary immune response.

UNIT-II:
Antigen-Antibody reactions - Ag-Ab binding, agglutination, blood groups, immunoflourescence, and important immunological diagnostic tests - ELISA, RIA, immuno blot, Immunodiffusion, Immunoelectrophoresis, Complement fixation test (CFT). Serological analysis of antibodies –isotypes, allotypes and idiotypes.
Antibody diversity, antigen receptors on B and T lymphocytes. Phagocytosis, opsination, Opsonins, monoclonal antibody production and polyclonal, Hybridoma techniques – Applications of monoclonal antibodies in biomedical research, clinical diagnosis and treatment. The complement system - components of classical and alternative complement pathways, complement receptors, biological, consequences of complement activation.

UNIT-III:
Humoral and cell-mediated immunity, ontogeny of B and T lymphocytes, generation of memory B cells and affinity maturation. T and B cell interactions, cytokines, lymphocyte mediated cytotoxicity (CTL). Antibody-dependent cell-mediated cytotoxicity. Reactions of immunity – antitoxins, neutralization of toxin with antitoxin. Immune response to infectious diseases: viral infections, bacterial infections, and protozoan diseases.

UNIT-IV:
Graft versus host reactions - Major Histocompatibility Complex (MHC). Human leucocyte antigen (HLA) restriction, Hypersensitive reactions – Auto immunity, transplantation immunity, Tumor immunology, immunological tolerance and immunosuppression.
Immunodeficiency diseases - Primary immunodeficiency (genetic) diseases due to B-cell and T-cell and combined defects (hypogammaglobulinemia, thymic aplasia, SCID). Secondary immunodeficiency (acquired).
Vaccines – development and production, vaccine expression system. Production of DNA vaccines. Immunotherapy of infectious diseases; Principles of immunization; vaccinoprophylaxis, vaccinotherapy, serotherapy.

Following are the papers of 2nd semester for the years 2016-17, 2017-18 & 2018-19

MB201 MICROBIAL PHYSIOLOGY AND METABOLISM

Unit I:

Nutritional types – autotrophic bacteria, chemosynthetic and photo synthetic microorganisms; Heterotrophic bacteria – saprophytes, parasites and mixotrophs; Respiration in bacteria – aerobic and anaerobic types of respiration, obligate aerobes, facultative anaerobes and obligate anaerobes; Toxic effect of oxygen on anaerobes; Bioluminescence in microorganisms; Energy yields; Microbial growth- The concept of growth and definition, Cell cycle in microbes and generation time- Growth phases of bacteria –survival of microbial cells; Importance of each growth phase; Synchronous cultures – methods of synchronous culturing, Continuous culturing methods, factors effecting growth; Methods of growth measurement; Physiology and biochemistry of sporulation and germination of spores.

Unit II:

Carbohydrate metabolism in microbes – synthesis of carbohydrates in photosynthetic, chemosynthetic and heterotrophic microbes; Fermentation of carbohydrates by microorganisms –Embden-Meyerhof-Parnas pathway, Entner-Doudoroff (ED) pathway, C2- C4 split pathway; Kreb's cycle, glyoxylate cycle, hexose monophosphate shunt (HMP), gluconeogenesis, anaplerotic reactions, synthesis of peptidoglycans and glycoproteins; Anaerobic respiration -Fermentation, Biochemical mechanisms of lactic acid, ethanol, butanol and citric acid fermentations; Nitrate and sulphate respiration.

Unit III:

Metabolism of amino acids –Biosynthesis of amino acids and their regulation with emphasis on tryptophan and histidine by microorganisms; Protein metabolism - Assimilation of inorganic nitrogen and sulphur, Biochemistry of nitrogen fixation; Urea cycle; Signal transduction with reference to nitrogen metabolism; Catabolism of amino acids, transamination, decarboxylation and oxidative deamination; Porphyrin biosynthesis and catabolism.

UNIT IV:

Lipid metabolism - Biosynthesis of triacylglycerols, phospholipids and sphingolipids; Oxidation of saturated and unsaturated fatty acids; Microbial metabolism of aromatic and aliphatic hydrocarbons (camphor, 2,4-D and toluene); Nucleotide metabolism - Biosynthesis of purine and pyrimidine nucleotides, biosynthesis of deoxyribonucleotides; Regulation of nucleotide synthesis, catabolism of purine and pyrimidines; Secondary metabolism - Utilization of secondary metabolites for production of vitamins, toxins(aflatoxin and corynebacterial), hormones (GA), and antibiotics (penicillin and streptomycin).

MB202 CELL BIOLOGY AND ENZYMOLOGY

Unit I:

Structure & function of chloroplast and mitochondria, mesosomes, lysosomes and cytoskeletal system;

Photosynthesis in bacteria; Physicochemical properties of bacteria – intracellular osmotic pressure, permeability of the bacterial cell; Nutrient transport – simple diffusion, active, passive and facilitated diffusion; Purple green photosynthetic bacteria; Photosynthesis
- Oxygenic and anoxygenic photosynthesis, structure of synthetic pigments of PS I and PS II, and photosynthetic electron transport, CO_2 fixation, halobacterial photosynthesis.

Unit II:

Cell cycle – Mitosis and Meiosis; cell cycle regulation mechanism; Signal transduction- Protein kinases, phosphorylation cascades, Ras pathway, MAP kinase pathway, etc; Cyclic nucleotides, G proteins; Mechanisms of protein translocation across membranes in prokaryotes, coated vesicles, membrane receptors.

Unit III:

Outlines of enzyme classification, nomenclature, assay of enzymes and kinetics of enzyme catalyzed reactions – Michaelis – Menton equation, determination of Km, Vmax and Kcat values; Factors affecting enzyme reaction – pH, temperature, radiation, enzyme and substrate concentrations, activators, coenzymes and metalloenzymes; Ribozymes and abzymes.

Unit IV:

Enzyme inhibitors, competitive and noncompetitive inhibition; Active site determination; Mechanism of action of ribonuclease, lysozyme and chymotrypsin; Isoenzymes, Regulatory enzymes – covalent modification, zymogen activation, Allosteric enzymes – ATCase, Glutaminesynthetase; Hemoglobin& Myoglobin; Enzyme purification - Methods of isolation, purification; Recovery and yield of enzymes; Criteria for testing purity of enzyme preparations; Immobilised enzymes - Methods of immobilisation; Applications of immobilized enzymes.

MB203 MOLECULAR AND MICROBIAL GENETICS

Unit I:

Molecular organization of chromosomes in Prokaryotes and Eukaryotes; Centromeres and telomeres; Recombination at molecular level, heteroduplex analysis; Fine Structure analysis; Organisation of genomes – Repeated sequences - C value – cot curves" Multigene families; Molecular markers(RFLP and RAPD) Polymorphisms; Yeast & Drosophila as model organisms; Complementation and functional allelism.

Unit II:

Plasmids – types, plasmid DNA properties; Sex plasmid, F and its derivatives, drug resistance
(R) plasmids; The Ti plasmid of Agrobacterium; Hybridization in yeast, control of mating type loci in yeast; Transposable elements – transposition; Types of bacterial transposons, duplication of target sequence at an insertion site; Deletion and inversion caused by transposons; Transposable elements in yeast and Drosophila; Retroposons.

Unit III:

Mutations –types of mutations, Molecular basis of mutations, isolation & analysis of mutants; Mutagenesis – base analogue mutagens, chemical mutagens, intercalating substances, mutator gene; Site directed mutagenesis, mutational hot spots, Reversion, second site revertants, frame shift mutations, carcinogens, screening of mutants; UV damage of DNA and repair.

Unit IV:

Bacterial genetics – Inheritance of characteristics and variability; Phenotypic changes due to environmental alterations; Genotypic changes; Bacterial recombination; Bacterial conjugation; Transduction – Generalized and specialized transductions; Bacterial transformation; Tetrad analysis in eukaryotic microbes – Neurospora and yeast; Mapping of bacterial chromosome by interrupted mating and transduction; Recombination in bacteriophages; Benzer's studies on r-II locus of T4 bacteriophage; Complementation test.

MB204 IMMUNOLOGY

Unit I:

History and scope of immunology, cells involved in immune system – T-lymphocytes, B- lymphocytes, monocytes, macrophages, APC, Neutrophils, mast cells; Types of immunity- Adaptive immunity, innate immunity; Lymphoid organs, Thymus, bone marrow, spleen, lymph nodes; Antigen-Antibody reactions - Ag-Ab binding, agglutination, blood groups, immunoflourescence and important immunological diagnostic tests - ELISA, RIA, immunoblot, Immunodiffusion, Immunoelectrophoresis, Complement fixation test (CFT).

Unit II:

Nature of antigens; antibody structure, classification of antibodies, functions of IgG, IgA, IgM, IgD and IgE; primary and secondary immune response; serological analysis of antibodies –isotypes, allotypes and idiotypes; Antibody diversity, antigen receptors on B and T lymphocytes; Phagocytosis, opsination, Opsonins and polyclonal and monoclonal antibody production (Hybridoma techniques) – Applications of monoclonal antibodies in biomedical research, clinical diagnosis and treatment; The complement system - components of classical and alternative complement pathways, complement receptors, biological, consequences of complement activation.

Unit III:

Humoral and cell-mediated immunity**,** ontogeny of B and T lymphocytes, generation of memory B cells and affinity maturation; T and B cell interactions, cytokines, lymphocyte mediated cytotoxicity (CTL); Antibody-dependent cell-mediated cytotoxicity; Reactions of immunity – antitoxins, neutralization of toxin with antitoxin; Immune response to infectious diseases: viral infections, bacterial infections, and protozoan diseases.

Unit IV:

Graft versus host reactions - Major Histocompatibility Complex (MHC); Human leucocyte antigen (HLA) restriction, Hypersensitive reactions – Auto immunity, transplantation immunity, Tumor immunology, immunological tolerance and immunosuppression; Immunodeficiency diseases - Primary immunodeficiency (genetic) diseases due to B-cell and T-cell and combined defects (hypogammaglobulinemia, thymic aplasia, SCID); Secondary immunodeficiency (acquired); Vaccines – development and production, vaccine expression system; Production of DNA vaccines; Immunotherapy of infectious diseases; Principles of immunization; vaccinoprophylaxis, vaccinotherapy, serotherapy.

Following are the papers of 3rd semester for the years 2013-14, 2014-15 & 2015-16

MB 301: MOLECULAR BIOLOGY

UNIT-I:

Proof of DNA & RNA as genetic material; Transformation experiments, Blenders experiments, properties of genetic material. Modern concept of gene structure. Overlapping genes, split genes, constitutive genes, jumping genes, Oncogenes.
Types of tumors, physical, chemical and biological Carcinogens, chromosomal changes induced by Carcinogens.

UNIT-II:

DNA replication – various modes of replication, Meselson-Stahl's studies on replication. Enzymes and Proteins involved in replication; Mechanism of replication – Initiation, polymerization and temination. Topoisomerases, DNA ligases. Procaryotic and Eucaryotic promoters. Mechanism of transcription and transcriptional activators. Posttranscriptional modifications.

UNIT-III:

The genetic code: Deciphering the genetic code; theory of triplet code, elucidation of base composition of codons. Identification of stop and start codons, universality of the code, redundancy of the code, the decoding system.
Protein synthesis: Mechanism and role of various factors involved in Initiation, elongation and termination of Protein Synthesis, Inhibitors of protein synthesis. Mechanisms of protein translocation, Post translational processing of proteins, protein channeling, and role of RNA in protein synthesis.

Unit-4:

Regulation of gene expression at the levels of transcription and translation. Operon concept; Regulatory genes, structural genes and repressors. Negative and Positive regulation. Regulation of lac, ara and trp operons. Catabolite repression. Regulation of gene expression in lambda and nif operon. Regulation of gene expression in eucaryotes.

MB 302: MEDICAL MICROBIOLOGY

UNIT-I:

Normal microbial flora of human body, host microbe interactions. Infection and infection process- routes of transmission of microbes in the body. Description and pathology of diseases caused by bacteria; *Streptococcus, Pneumococcus, Gonococcus*, Enterobacteriaceae, *E. coli*, *Salmonella, Shigella, Pseudomonas, Klebsiella, Proteus, Vibrio cholera. Brucella, Haemophilus influenzae*; Pathogenic anaerobes: *Tetanus, Clostridia, Conynebacteria, Mycobacteria, Spirochaetes.*

UNIT-II:

Description and pathology of diseases caused by *Aspergillus, Penicillium*, Mucomycosis, Blastomycosis, Microsporosis, Rhinosporidium, Epidermophyscosis. Description and pathology of diseases caused by hemoflagellates; *Leishmania donavani, L.tropica*, *Trypanosoma gambiense*; intestinal flagellates; *Trichomonas, Giardia*, *Entamoeba histolytica*, malarial parasites, Helminthes; *Ascaris lumbricoides*, Hook worm, pinworm, Filarial parasites.

UNIT-III:

Laboratory diagnosis of Common infective syndromes and parasitic manifestations; Methods of transmission and role of vectors- biology of vectors. (1) House fly (2) Mosquitoes (3) sand fly. Need and significance of epidemiological studies. Epidemiological investigations to identify a disease, Principles of chemotherapy, Antibacterial drugs (Penicillin, Streptomycin, Sulfonamides and Polymyxins), Antifungal drugs (Nystatin), and Antiviral agents. (Robovirin) Problems of drug resistance and drug sensitivity. Drug resistance in bacteria.

UNIT-IV:

Viral diseases: pathology and lab diagnosis of diseases caused by pox viruses; herpes virus (chicken pox- zoster); orthomyxo and paramyxo viruses; adenovirus, other respiratory viruses, (Influenza, Rhyno) viruses affecting nervous system (ex: Polio virus, Rabies virus), enterovirus, reovirus, viral hepatitis, HIV. Interferon – Nomenclature, types & classification, Induction of interferon, types of inducers.

MB 303: BIOSTATISTICS & BIOINFORMATICS

UNIT-I:

Biostatistics: Measures of Central tendency and distribution – mean, median, mode, range, standard deviation, variance. 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. Correlation and Linear regression.

UNIT-II:

Sequence Analysis: Introduction to hidden Markov models. Introduction to biological databases: NCBI, EMBL, EXPASY, PIR, Pfam. Concept of World Wide Web: HTML, HTPP. Similarity measures - Euclidean, Mahalanobis distance, Edit distance, similarity matrices (PAM, BLOSUM) Searching sequence databases using BLAST. Pairwise sequence alignment using dynamic programming (Needleman – Wunsch & Smith – Waterman algorithms.) Multiple sequence alignment – progressive alignment – profiles – multidimensional dynamic programming.

UNIT-III:

Genomics and proteomics: Molecular phylogenetics: Construction of phytogenetic trees using parsimony method and branch & bound method. Clustering methods – UPGMA & neighbor-

joining, Analysis of gene expression data by clustering. Gene prediction – Statistical approaches – Similarity based approaches gene annotation. Fragment assembly, peptide sequencing using mass and spectroscopy data. Comparative genomics.

UNIT-IV

Modeling: Protein secondary structure prediction – Chou Fasman rules – neural networks – discriminant analysis. Prediction of transmembrane segments in membrane proteins. Protein 3D structure prediction – homology – threading – potential energy functions – energy minimization – molecular dynamics – simulated annealing.

MB 304: MOLECULAR BIOTECHNOLOGY

UNIT-I:

r-DNA technology- Isolation of nucleic acids, DNA sequencing, maxam-Gilbert and Di-deoxy methods. Restriction endonucleases, restriction maps, Southern, Northern blotting and western blotting. DNA finger printing, PCR- principle, types, application.

UNIT-II:

Cloning vectors- Plasmids, Cosmids and bacteriophages. Ligases- DNA ligases, ligation of fragments with cohesive ends & blunt ends; homopolymer tailing, Cloning strategies – shot gun experiments, gene libraries. Isolation of poly mRNA, synthesis of c-DNA, cloning of c-DNA in bacteria. Isolation of cloned genes, identification of recombinants, structural and functional analysis of recombinants.

UNIT-III

Gene expression- expression of cloned genes in bacteria, yeast, plant and animal cells. Application of recombinant DNA technology in biology, plant, medicine, genetic diseases, gene therapy. Nanotechnology: Basic Principle and Applications: Biosensors, drug and gene delivery systems, chip technologies, nano imaging, Nanomedicine and Cancer diagnostics and treatment.

UNIT-IV

Nucleic acid probe technology, DNA micro array – printing of oligonucleotides and PCR products on glass slides, nitrocellulose paper. Whole genome analysis for global patterns of gene expression using fluorescent-labelled c-DNA or end labeled RNA probes. Analysis of single nucleotide polymorphisms using DNA chips. Protein micro array, advantages and disadvantages of DNA and protein micro arrays.

Following are the papers of 3rd semester **for the years 2016-17, 2017-18 & 2018-19**

MB301 MOLECULAR MICROBIOLOGY

Unit I:

DNA & RNA as genetic material; Transformation experiments, Blenders experiments, properties of genetic material; Modern concept of gene structure; Overlapping genes, split genes, constitutive genes, jumping genes, Oncogenes; Types of tumors, physical, chemical and biological Carcinogens, chromosomal changes induced by Carcinogens.

Unit II:

DNA replication –various modes of replication, Meselson-Stahl's studies on replication; Enzymes and Proteins involved in replication Mechanism of replication – Initiation, polymerization and termination; Topoisomerases, DNA ligases; Prokaryotic and Eukaryotic promoters; Mechanism of transcription and transcriptional activators; Posttranscriptional modifications.

Unit III:

The genetic code- Deciphering the genetic code; theory of triplet code, elucidation of base composition of codons; Protein synthesis- Mechanism and role of various factors involved in Initiation, elongation and termination of Protein Synthesis, Inhibitors of protein synthesis; Post translational processing of proteins, protein channelling, role of RNA in protein synthesis.

Unit IV:

Regulation of gene expression at the levels of transcription and translation; Operon concept; Regulatory genes, structural genes and repressors; Negative and Positive regulation; Regulation of *lac*, *ara* and *trp* operons; Catabolite repression; Regulation of gene expression in lambda and *nif* operon.

MB302 GENETIC ENGINEERING

Unit I:

r-DNA technology- Isolation of nucleic acids, DNA sequencing, Maxam-Gilbert and Dideoxy methods; Restriction endonucleases, restriction maps, Southern, Northern and western blotting; DNA finger printing, PCR- principle, types, application.

Unit II:

Cloning vectors- Plasmids, Cosmids and bacteriophages; Ligases- DNA ligases, ligation of fragments with cohesive ends & blunt ends; homopolymer tailing, Cloning strategies – shot gun experiments, gene libraries; Isolation of poly mRNA, synthesis of c-DNA, cloning of c-DNA in bacteria; Isolation of cloned genes, identification of recombinants, structural and functional analysis of recombinants.

Unit III:

Gene expression- expression of cloned genes in bacteria, yeast, plant and animal cells; Applications of recombinant DNA technology in biology, plant, medicine, genetic diseases, gene therapy.

Unit IV:

Nucleic acid probe technology, DNA micro array – printing of oligonucleotides and PCR products on glass slides, nitrocellulose paper; Whole genome analysis for global patterns of gene expression using fluorescent-labeled c-DNA or end labeled RNA probes; Analysis of single nucleotide polymorphisms using DNA chips; Protein micro array, advantages and disadvantages of DNA and protein micro arrays.

MB303 BIOINFORMATICS, MICROBIAL GENOMICS AND PROTEOMICS

Unit I:

Introduction to Biological Databases - Types of databases, Nucleic Acid Sequence databases, Protein sequence database; Genomics, Transcriptomics, Proteomics and Metabolomics.

Bioinformatics and its applications - Structure-function relationship; Sequence assembling using computer; Computer applications in molecular biology, Protein domains and human genome analysis program (BLAST, FASTA, GCC etc.); Databases for nucleic acid and protein sequences (EMBL, GenBank), database for protein structure (PDB), accessing information (Network expasy, EMB Net, ICGEB Net).

Unit II:

Proteomics - Proteome, metaproteome, structural proteomics, functional proteomics; Protein structure analysis, sequence based protein prediction; Homology or comparative modeling- Remote homology (Threading), Protein function prediction- Introduction to the concepts of molecular modeling; Drug discovery, Structure based drug designing and virtual screening by automated docking, de novo sequence; Molecular docking, evaluation of docking prediction.

Unit III:

Genomics - Whole genome analysis-Preparation of ordered cosmid libraries, bacterial artificial chromosomal libraries, shotgun libraries and sequencing, conventional sequencing (Sanger, Maxam and Gilbert Methods), automated sequencing; Sequence analysis - Computational methods, homology algorithms (BLAST) for proteins and nucleic acids, open reading frames, annotations of genes, conserved protein motifs related structure / function (PROSITE, PFAM, Pro Scan); DNA analyses for repeats (Direct and inverted), palindromes, folding programmes; Benefits of Pharmacogenomics.

Unit IV:

Integration of omic approaches - Application of omic technologies in bioprospecting, biodegradation and medicine; Systems approaches using high through put technologies for biomining microorganisms; Strategies for the analysis of bacterial biodegradation path ways, Concept of Laboratory-on-a-chip (LOC); Omic tools - 2DE, MALDI – TOF, LC – MS/MS analysis, ICAT, ITRAQ, AQUA, ESI –Q-IT-MS, SELDI – TOF-MS, yeast two hybrid analysis.

MB304 MEDICAL MICROBIOLOGY

Unit I:

Normal microbial flora of human body, host-microbe interactions; Infection and infection process- routes of transmission of microbes in the body; Description and pathology of diseases caused by bacteria; Streptococcus, Pneumococcus, Gonococcus, Enterobacteriaceae, E. coli, Salmonella, Shigella, Pseudomonas, Klebsiella, Proteus, Vibrio cholera; Brucella, Haemophilus, influenzae; pathogenic anaerobes, Tetanus, Clostridia, Corynebacteria, Mycobacteria, Spirochaetes**.**

Unit II:

Description and pathology of diseases caused by Aspergillus, Penicillium, Mucomycosis, Blastomycosis, Microsporosis, Rhinosporidium, Epidermophyscosis; Description and pathology of diseases caused by hemoflagellates; Leishmaniadonavani, L.tropica, Trypanosoma gambiense; intestinal flagellates; Trichomonas, Giardia, Entamoeba histolytica, malarial parasites, Helminthes; Ascaris lumbricoides, Hook worm, pinworm, Filarial parasites.

Unit III:

Laboratory diagnosis of Common infective syndromes and parasitic manifestations; Methods of transmission and role of vectors- biology of vectors; (1) House fly (2) Mosquitoes(3) sand fly; Need and significance of epidemiological studies; Epidemiological investigations to identify a disease, Principles of chemotherapy, Mode of antibiotics - Penicillin, streptomycin, sulfonamides and Polymyxins; Antifungal drugs (Nystatin), Antiviral agents (Robovirin); Problems of drug resistance and drug sensitivity; Drug resistance in bacteria.

Unit IV:

Viral diseases- Description, pathology and lab diagnosis of diseases caused by poxviruses; herpes virus (chicken pox- zoster); orthomyxo and paramyxo viruses; adenovirus, otherrespiratory viruses, (Influenza, Rhino) viruses affecting nervous system (ex: Polio virus, Rabiesvirus), enterovirus, reovirus, viral hepatitis, HIV; Interferon – Nomenclature, types &classification, Induction of interferon, types of inducers.

Following are the papers of 4^{th} semester for the years 2013-14, 2014-15 & 2015-16

MB 401: FERMENTATION TECHNOLOGY & INDUSTRIAL MICROBIOLOGY

UNIT-I:

An introduction to fermentation processes – the range of fermentation processes. Microorganisms used in industrial microbiological processes – the isolation, maintenance and strain improvement of industrially important microorganisms, screening methods, isolation of autotrophic mutants. Media and materials required for industrial microbiological processes, Antifoams.

UNIT-II:

Microbial growth kinetics, batch culture, continuous culture, fed batch culture and Dual or multiple fermentations. Inoculum development for large-scale processes. Design of fermentor: Construction and maintenance of aseptic conditions. Control of various parameters. Sterilization of media and Containment facility. Types of fermentors and fermentations. Computer application in fermentation technology. Recovery and purification of fermentation products (downstream process). Fermentation Economics.

UNIT-III:

Production of ethyl alcohol, beer & wine. Biofilms, biosurfactants, Biotransformation with reference to steroids and non steroids, Petroleum Microbiology. Microbial leaching- role of microorganisms in the recovery of minerals (uranium, copper) from ores.

UNIT-IV:

Microbial products from genetically modified (cloned) organisms ex: insulin. Microbial groups involved in biogas production, design of digester. Patenting: Concept and its composition & protection of right and their limitation, intellectual property rights (IPR); patenting biotechnology inventions.

MB 402: ENVIRONMENTAL MICROBIOLOGY

UNIT-I:
Basic concepts of Ecology and Environment – Biological spectrum at levels of organization & realm of ecology. Ecosystem – Concept, components, food chains, food webs and tropic levels. Energy transfer efficiencies between tropic levels. Biological factors influencing the growth and survival of microorganisms- inter reactions of microbial population and community dynamics – Growth in closed environments and in open environments. The kinetic properties of competition between microbial populations. Kinetic principles of preypredator relationship.

UNIT-II:
Aquatic environment: Fresh water microorganisms, their zonation and characteristics. Salt water, oceans, estuaries, microorganism their zonation and characteristics. Faecal pollution of waters – water borne diseases, indicator organisms. IMVIC test, Determination of water potability by MPN and sanitary examination. Atmospheric Environment: Dispersal of airborne microorganisms. Air Sampling principles and techniques. Air spora: Concepts and components, indoor and outdoor air spora. Diurnal periodicity patterns. Seasonal periodicity patterns. Vertical profiles.

UNIT-III:
Microorganisms and chemical pollutants: methyl mercury, trimethyl arsine, hydrogen sulphide, acid rain water, carbon monoxide, ammonia, nitrate, nitrogen oxides, nitrosamines, Eutrophication, algal toxins. Microorganisms and sewage treatment: COD, BOD & DO, trickling filters, activated sludge process, oxidation ponds; sludge treatment (anaerobic digestion).

UNIT-IV:
Bio-magnification and Bioremediation Technology – Microbial degradation of oil spills, pesticides and detergents, Biofouling; Bioplastics PHB, PHA. Fate of genetically engineered microorganisms in the environment. Environmental impact assessment studies. Deterioration of materials – paper, textiles, painted surfaces, prevention of microbial deterioration.

MB 403: FOOD MICROBIOLOGY & AGRICULTURAL MICROBIOLOGY

UNIT-I:
Microbiology of foods – Microbial flora of fresh foods, grains, fruits, vegetables, milk, meat, eggs and fish and their infestation by bacteria, fungi and viruses. Microbiological examination of foods- microscopic techniques and cultural techniques. Direct microscopic examination, total colony counts and differential enumeration. Identification of specific groups – Bacteria, Viruses, Fungi and Protozoa. Microbial spoilage of milk, food, types of spoilage organisms, food poisoning, mycotoxins and bacterial toxins.

UNIT-II:
Food processing & preservation: Methods of food preservation, Aseptic handling, pasteurization of milk, refrigeration and freezing, dehydration, osmotic pressure, chemicals –
organic acids, nitrates, nitrites and cresols; Radiation – UV light, Y-irradiation. Fermented foods – preparation of Yogurt, Streptococcus species, *Lactobacillus bulgaricus*; Manufacture of cheese; *Penicillium roqueforti*. Fermented soybean products. Microorganisms as food – single cell protein, yeast, algae and fungal biomass production.

UNIT-III:

Soil Environment- Microorganisms, soil structure, soil profile, Physico-chemical conditions, Microbial composition, sampling techniques, role of Microorganisms in organic matter decomposition (cellulose, Hemicellulose, Lignins) Bio-geo chemical cycles – Carbon cycle, Nitrogen cycle – Nitrogen fixation, nitrification, denitrification, sulpher, iron and phosphorus cycles. Rhizosphere – Rhizosphere Microorganisms, Biochelators (Siderophores).

UNIT-IV:
Biofertilizers – Introduction, biofertilizers using nitrogen fixing microbes – phosphate solubilization- Rhizobium, Azatobacter, Azospirillum, Azolla; Anabaena Symbiosis, blue green algae, Mycorrihiza, Biopesticides – toxins from *Bacillus thuringiensis, Psuedomonas syringae,* Biological Control – Use of Baculovirus, NPV virus, protozoa & fungi in biological control.

MB 404: PHARMACEUTICAL MICROBIOLOGY

UNIT-I:
Chemical disinfectants, antiseptics and preservatives and their industrial significance. Production of antibiotics – Penicillin, Streptomycin, Erythromycin, bacitracin and tetracycline. Mechanism of action of antibiotics – the bacterial cell wall, protein synthesis, chromosome function & replication, folate antagonis, the cytoplasmic membrane, Assay of antibiotics – Penicillin, Streptomycin.

UNIT-II:
Good manufacturing and Good Laboratory practices, Regulatory aspects and quality control, Quality assurance and quality management in pharmaceuticals ISO, WHO, US FDA, Documentation, Validation. Personal management, training, Personal Hygiene and Health.

UNIT-III:
Industrial Production of Enzymes – amylases, Proteases, organic acids- lactic acid, citric acid, vinegar, aminoacids – L-lysine, L-glutamic acid; Food supplements and hormones. Production of Vitamin B_{12}. Analytical Microbiology – microbiological assays of Vitamins (Riboflavin, B_{12}), amino acids (lysine, tryptophan).

UNIT-IV:
Ecology of Microorganisms as it effects the pharmaceutical industry; Microbial spoilage & preservation of medicines using antimicrobial agents; Control of microbial risk in medicines microbial limit tests and endotoxin tests, Contamination of non-sterile pharmaceuticals in hospital & community environments.

Following are the papers of 4th semester for the years 2016-17, 2017-18 &

2018-19

MB401 FERMENTATION TECHNOLOGY AND INDUSTRIAL MICROBIOLOGY

Unit I:

An introduction to fermentation processes – the range of fermentation processes; Microorganisms used in industrial microbiological processes – isolation, preservation and strain improvement of industrially important microorganisms, screening methods, isolation of autotrophic mutants; Media and materials required for industrial microbiological processes – Antifoams.

Unit II:

Microbial growth kinetics, batch culture, continuous culture, fed batch culture and Dual or multiple fermentations; Inoculum development for large-scale processes; Design of fermenter-Construction and maintenance of aseptic conditions; Control of various parameters; Sterilization of media; Types of fermenters; Computer application in fermentation technology; Recovery and purification of fermentation products; Fermentation Economics.

Unit III:

Production of ethyl alcohol, beer & wine; Enzyme probe biosensors, biochips, biofilms, bio surfactants, Biotransformation, Petroleum Microbiology; Microbial leaching- role of microorganisms in the recovery of minerals (uranium, copper) from ores.

Unit IV:

Microbial products from genetically modified (cloned) organisms ex: insulin; Microbial groups involved in biogas production, design of digester; Patenting- Concept and its composition & protection of right and their limitation, intellectual property rights (IPR); patenting biotechnology inventions.

MB402 ENVIRONMENTAL MICROBIOLOGY

Unit I:

Basic concepts of Ecology and Environment – Biological spectrum at levels of organization & realm of ecology; Ecosystem – Concept, components, food chains, food webs and tropic levels; Energy transfer efficiencies between tropic levels; Biological factors influencing the growth and survival of microorganisms- inter reactions of microbial population and community dynamics – Growth in closed environments and in open environments; The kinetic properties of competition between microbial populations; Kinetic principles of prey-predator relationship.

Unit II:

Aquatic environment- Fresh water microorganisms, their zonation and characteristics- Salt water, oceans, estuaries, microorganism their zonation and characteristics-Faecal pollution of waters – water borne diseases, indicator organisms; IMVIC test, sanitary examination of water; Atmospheric Environment- Dispersal of airborne microorganisms; Air Sampling principles and techniques; Air spora- Concepts and components, indoor and outdoor air spora; Diurnal periodicity patterns; Seasonal periodicity patterns; Vertical profiles.

Unit III:

Microorganisms and pollution- Microbial production of methyl mercury, trimethyl arsine, hydrogen sulphide, acid rain water, carbon monoxide, ammonia, nitrate, nitrogen oxides, nitrosamines, Eutrophication, algal toxins; Microorganisms and sewage treatment- COD, BOD & DO, trickling filters, activated sludge process, oxidation ponds; sludge treatment (anaerobic digestion).

Unit IV:

Bioremediation Technology – Microbial degradation of oil spills, pesticides and detergents, Biofouling; Fate of genetically engineered microorganisms in the environment; Environmental impact assessment studies; Deterioration of materials – paper, textiles, painted surfaces, prevention of microbial deterioration.

MB403 FOOD AND AGRICULTURE MICROBIOLOGY

Unit I:

Microbiology of foods – Microbial flora of fresh foods, grains, fruits, vegetables, milk, meat, eggs and fish and their infestation by bacteria, fungi and viruses; Microbiological examination of foods- microscopic techniques and cultural techniques; Direct microscopic examination, total colony counts and differential enumeration; Identification of specific groups – Bacteria, Viruses, Fungi and Protozoa; Microbial spoilage of milk, food, types of spoilage organisms, food poisoning, mycotoxins and bacterial toxins.

Unit II:

Food processing & preservation- Methods of food preservation, Aseptic handling, pasteurization of milk, refrigeration and freezing, dehydration, osmotic pressure, chemicals – organic acids, nitrates, nitrites and cresols; Radiation – UV light, Y-irradiation; Fermented foods – preparation of Yogurt, streptococcus species, Lactobacillus bulgaricus; Manufacture of cheese, Pencillium; Fermented soybean products; Microorganisms as food – single cell protein, yeast, algae and fungal biomass production.

Unit III:

Soil Environment- Microorganisms, soil structure, soil profile, Physico-chemical conditions, Microbial composition, sampling techniques, role of microorganisms in organic matter decomposition (cellulose, Hemicellulose, Lignins) Bio-geo chemical cycles – Carbon cycle, Nitrogen cycle – Nitrogen fixation, nitrification, denitrification, sulphur, iron and phosphorus cycles; Rhizosphere – Rhizosphere Microorganisms, Biochelators (Siderophores).

Unit IV:

Biofertilizers – Introduction, biofertilizers using nitrogen fixing microbes – phosphate solubilization- Rhizobium, Azatobacter, Azospirillum, Azolla; Anabaena Symbiosis, blue green algae, Mycorrihiza, Biopesticides – toxins from Bacillus thuringiensis, Psuedomonassyringae, Biological Control – Use of Baculovirus, NPV virus, protozoa & fungi in biological control.

MB404 BIOSTATISTICS AND RESEARCH METHODOLOGY

Unit I:

Elements of Biostatistics: Introduction to Biostatistics; Methods of representation of statistical data; Data - Data types, collection of data, classification and tabulation, population and sample designs; Random and Non-random sampling methods, Handling of bulky data- construction a histogram- interpretation of histogram; Measures of Central tendency and distribution – mean, median, mode, Measures of variation - Range, quartile deviation, mean deviation and standard deviation; Coefficient of variation; Concept of Probability-Basic principles of probability theory, Bayes theorem, Normal distribution, statistical inference – Addition and multiplication theories, conditional probability and probability distributors; Binomial, poission and normal distribution.

Unit II:

Statistical applications in biology- Experimental designs; measures of dispersion- standard deviation, standard error; Concept of correlation and linear regression; Regression coefficients and properties; Types of errors and levels of significance; Tests of significance- Comparison of variance (F-test), small sample test, Student's "t" test, Paired and unpaired t test, chi square test; Analysis of variance (ANOVA) – one way and two way, multiple comparisons; Introduction to hidden Markov models.

Unit III:

Basics of Research Methodology - Literature survey, origin and identification of problem, Formulation hypothesis based on existing information, Validation of hypothesis, Designing experimental techniques for validating the hypothesis, Execution of designed experiments, Analysis of data, Interpretation of research findings, Preparation of PhD thesis, Oral presentation.

Unit IV:

Methodology for writing science report- Compilation of experimental record, program of writing, use of vocabulary, art of illustration, technical report writing, editing and correcting, manuscript writing for publication in peer reviewed scientific journals.

Research Project submission and execution- Preparation of informal proposal, modified proposal and formal proposal; Experimental design and Collection of results, submission of progress report (year wise) and submission of technical report (Format- Title page, Introduction, Aims of the proposal/research, methodology, results, references, acknowledgments, budgetary preparation); Submission of final technical report, Patenting and intellectual property rights.