Sl. No.	Paper Code	Title of the Paper	L	T	P	No. of Credits	No of Hrs./Week
1		General Microbiology	3	1	0	4	4
2		Biochemistry	3	1	0	4	4
3		Instrumentation and Biophysics	3	1	0	4	4
		Virology	3	0	0	3	3
4		Microbiology Lab	0	0	2	2	4
5		Biophysics Lab	0	0	2	2	4
6		Biochemistry Lab	0	0	2	2	4
7		PROJECT & SEMINAR-I	0	0	1	1	
8		SKILL DEVELOPMENT-I	0	0	1	1	
TOTAL						**23**	

Sl. No.	Paper Code	Title of the Paper	L	T	P	No. of Credits	No of Hrs./Week
1		Immunology	3	1	0	4	4
2		Fermentation and Bioprocess Technology	3	1	0	4	4
3		Microbial Molecular Biology and Genetics	3	1	0	4	4
		Microbial Physiology and Cell Biology	3	0	0	3	3
4		Microbial Molecular Biology and Genetics Lab	0	0	2	2	3
5		Immunology Lab	0	0	2	2	3
6		Fermentation and Bioprocess Technology Lab	0	0	0	2	3
7		PROJECT & SEMINAR-II	0	0	1	1	
8		SKILL DEVELOPMENT-II	0	0	1	1	
TOTAL						**23**	

Sl. No.	Paper Code	Title of the Paper	L	T	P	No. of Credits	No of Hrs./Week
1		Recombinant DNA Technology	3	1	0	4	4
2		Medical Microbiology	3	1	0	4	4
3		Bioinformatics and C Programming	3	1	0	4	4
4		Biostatistics	3	0	0	3	3
5		RDT Lab	0	0	2	2	4
6		Bioinformatics and C Programming Lab	0	0	2	2	4
7		Project	0	0	6	6	9
8		PROJECT & SEMINAR-III	0	0	1	1	
9		SKILL DEVELOPMENT-III	0	0	1	1	
TOTAL						**27**	

Sl. No.	Paper Code	Title of the Paper	L	T	P	No. of Credits	No of Hrs./Week
1		Food and Industrial Microbiology	3	0	0	3	3
2		Environmental Microbiology	3	0	0	3	3
3		Soil and Agricultural Microbiology	3	0	0	3	3
4		Project	0	0	8	8	12
5		Seminar & Grand Viva	0	0	4	4	
6		Field Trip and Report Preparation	0	0	4	4	
7		PROJECT & SEMINAR-IV	0	0	1	1	
8		SKILL DEVELOPMENT-IV	0	0	1	1	
TOTAL						**27**	

M.Sc. in Microbiology Syllabus

Semester-I

General Microbiology 3-1-0=4

UNIT – I:

History and scope of Microbiology. Identification , characterization and classification of microorganisms. Principles of bacterial taxonomy and classification: - Bergy's manual and its importance. Concepts, nomenclature and taxonomic ranks:- general properties of bacterial groups. Major characteristics used in Taxonomy-morphological, physiological and metabolic, ecological, numerical taxonomy, genetic and molecular classification systems; the kingdoms of organisms and phylogenetic trees. Distinguish 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.

UNIT- II:

Methods of sterilization: Physical methods – Dry heat, moist heat, radiation methods, filtration methods, chemical methods and their application. Concept of containment facility, sterilization at industrial level. Microbial cultures: Concept of pure culture, Methods of pure culture isolation, Enrichment culturing techniques, single cell isolation, and pure culture development. Microscopic identification characteristics, staining methods – simple staining, differential staining, structural staining and special staining methods Microbiological media- Natural and synthetic; autotrophic, heterotrophic and phototropic 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 preservation, drying, glycerol cultures, freeze-drying (lyophilization). Advantages and disadvantages of each method.

UNIT -III:

Bacterial nutrition and growth kinetics- synchronous, stock,batch and continuous cultures. Growth measurement methods –Metabolic diversity, measurements of NAD, ATP, DNA, and Protein, CO2 liberated O2 consumed, extra cellular enzymes. 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 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. Characteristics of – blue green algae, dinoflagellates, thallus organization, products

of algae and their economic importance. Algal SCP, emphasis on Spirulina. Characteristics of protozoa-Morphology, nutritional reuirements, reproduction. Morphology, Life cycle and Pathology of Entamoeba histolytica, Plasmodium, Free Living Pathogenic Amoeba Naglaria & Acanthamoeba.

Instrumentation & Biophysics 3-1-0=4

Unit I

Basic Techniques - Buffers; Methods of cell disintegration; Enzyme assays and controls; Detergents and membrane proteins; Dialysis, Ultrafiltration and other membrane techniques

Spectroscopy Techniques - UV, Visible and Raman Spectroscopy; Theory and application of Circular Dichroism; Fluorescence; MS, NMR, PMR, ESR and Plasma Emission spectroscopy Infrared Spectroscopy – Principles of IR spectroscopy, vibrational spectra of biopolymers, Fourier transform of Infra Red spectroscopy, Instrumentation, factors influencing vibrational frequency (Vibronic coupling, H-bond, electronic factors, bond angles, etc) NMR Spectroscopy – Proton magnetic resonance spectra of proteins, 13C NMR spectra of proteins, 31P NMR studies, NMR spectra of nucleic acids, Fourier transform of NMR spectroscopy, Relaxation (ID spectra) X-Ray Crystallography – Instrumentation, Fourier transformation, Application.

Unit II

Chromatography Techniques - TLC and Paper chromatography; Chromatographic methods for macromolecule separation - Gel permeation, Ion exchange, Hydrophobic, Reverse-phase and Affinity chromatography; HPLC and FPLC; Criteria of protein purity

Electrophoretic techniques - Theory and application of Polyacrylamide and Agarose gel electrophoresis; Capillary electrophoresis; 2D Electrophoresis; Disc gel electrophoresis; Gradient electrophoresis; Pulsed field gel electrophoresis

Unit III

Centrifugation - Basic principles; Mathematics & theory (RCF, Sedimentation coefficient etc); Types of centrifuge - Microcentrifuge, High speed & Ultracentrifuges; Preparative centrifugation; Differential & density gradient centrifugation; Applications (Isolation of cell components); Analytical centrifugation; Determination of molecular weight by sedimentation velocity & sedimentation equilibrium methods.

Unit IV

Radioactivity - Radioactive & stable isotopes; Pattern and rate of radioactive decay; Units of radioactivity; Measurement of radioactivity; Geiger-Muller counter; Solid & Liquid scintillation counters (Basic principle, instrumentation & technique); Brief idea of radiation dosimetry; Cerenkov radiation; Autoradiography; Measurement of stable isotopes; Falling drop method; Applications of isotopes in biochemistry; Radiotracer techniques; Distribution studies; Isotope dilution technique; Metabolic studies; Clinical application; Radioimmunoassay.

Unit V

Microscopy- Basic concept, Light, Dark-field, phase contrast, fluorescence, confocal, scanning and transmission electron microscopy, Scanning Probe microscopy (AFM, STM)

Biochemistry 3-1-0=4

Unit I: Enzymes: General properties, Nomenclature and classification; Co-factors definition and function with special reference to the representative substances - a) Co-enzymes (NAD+, NADP+, Co-enzyme-A, TPP, Pyridoxal phosphate); b) Prosthetic groups (FAD+ - Succinic dehydrogenase); c) Metal ions: Zn2+, Mg2+, Fe2+, Fe3+, Mn2+ - required for enzyme action. Michaelis-Menten equation; Enzyme Inhibition – Competitive, Non-competitive, Regulatory enzymes-Allosteric, Feedback inhibition, Ribozyme (catalytic RNA) and Abzyme (use of antibody as enzyme).

Unit II: Carbohydrate metabolism: Aerobic respiration-Glycolysis (EMP-pathway) with energy production: entry of galactose & fructose in EMP-path; TCA-cycle with energy production: pentose-phosphate pathway, Fermentation - Glucose metabolism in anaerobic condition.

Unit III: Electron Transport Chain: ETC & ATP generation sites; ATP & ADP cycle (oxidationreduction potential and electromotive force). Photophosphorylation, oxidative phosphorylation (chemiosmotic theory)

Unit IV: Fatty acid metabolism: Oxidation of fatty acids, Metabolism of ketone bodies - Formation, utilization, excretion and clinical significance. Biosynthesis of fatty acids. Cholesterol-Biosynthesis, regulation, transport and excretion. Metabolism of lipoproteins. Eicosanoid metabolism.

Unit V: Amino acid metabolism: Overview of biosynthesis of nonessential amino acids. Catabolism of amino acid nitrogen - Transamination, deamination, ammonia formation and the urea cycle.Disorders of the urea cycle. Catabolism of carbon skeletons of amino acids. Conversion of amino acids to specialized products.

Unit VI: Nucleic acid metabolism: Metabolism of purines - De novo and salvage pathways for biosynthesis. Purine catabolism. Biosynthesis and catabolism of pyrimidines.

VIROLOGY 3-0-0=3

UNIT–I:

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

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-II:

Properties of Viruses- Biological properties of viruses – host range, transmissionvector, 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 – III:

Viral replication and genome expression – viral genomes- structure and complexity of viral genomes, diversity among viral genomes – DNA and RNA genomeslinear, 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 – chemical symptoms, immuno diagnosis, molecular methods used in viral diagnosis, prevation and control of viruses: prevation – sanitation, vector control, vaccines and immunization control – chemoprophylaxis, chemotherapy – anti viral drugs, interferon therapy, efficacy of infection control.

General Microbiology Lab 0-0-2=3

1. Laboratory rules, safety and regulation, First Aid and ethics.
2. Standardization of microscope, measurement of microbes and direct cell counting.
3. Culture techniques and microbe handling: adjustment of pH of the media, broth, solid, slant & slab and Plate culture technique.
4. Enrichment culture of Nitrogen fixer, Spore former, cellulose decomposer, sulphate reducing bacteria and phosphate solubilizer.
5. Plating of environmental samples on culture media, isolation of pure culture.

6. Observation of the different morphology, shape, size of bacteria, yeast, micro algae, Protozoa & Fungi, under light field microscope.
7. Staining method: Simple staining. Gram staining, Endospore staining, Acid-fast staining, Flagella staining, Capsule staining.
8. Determination of MIC of antibiotics by tube dilution method. Assay of antibiotics by agar cup method.
9. Phenol co-efficient.
10. Identification of pure prokaryote isolates following Bergey's Manual.
11. Microbial Growth measurement – turbidity, total counts, MPN technique, estimation of dry weight, Bacterial growth curve and generation time. Effect of pH and temperature on bacterial growth.

Biophysics Lab 0-0-2=3

1. Native gel electrophoresis of proteins
2. SDS-polyacrylamide slab gel electrophoresis of proteins under reducing conditions.
3. Preparation of the sub-cellular fractions of rat liver cells.
4. Preparation of protoplasts from leaves.
5. Separation of amino acids by paper chromatography.
6. To identify lipids in a given sample by TLC.
7. To verify the validity of Beer's law and determine the molar extinction coefficient.

Biochemistry Lab 0-0-2=3

1. Making of Buffers
2. One dimensional TLC of amino acids and Carbohydrates
3. Two dimensional TLC of amino acids and Carbohydrates
4. Isolation and precipitation of proteins from natural sources and Wavelength scan of proteins
5. Estimation of proteins by Lowry and Brandford methods
6. Thermal unfolding of proteins and calculations of thermo-dynamic parameters from temperature scanning UV spectrophotometer, Effect of solvent conditions on thermal stability of proteins.
7. pH titrations of protein, calculation of net charge and total charge at a particular pH.
8. Reduction of disulphide bonds of proteins.
9. Estimation of DNA by chemical means and wavelength scan of DNA
10. Melting studies of calf thymus DNA
11. Effect of temperature, time and substrate concentration on salivary alpha amylase activity

Semester-II

Microbial Molecular Biology and Genetics 3-1-0=4

Unit I: DNA Replication and Repair

Unit of replication, enzymes involved in replication origin and replication fork, fidelity of replication, extrachromosomal replicon, DNA damage and repair; types of damage (deamination, oxidative damage, alkylation, pyrimidine dimmers) repair path-methyl directed mismatch repair, very short patch repair, nucleotide excision repair, excision repair, recombination repair, SOS system.

Unit II : Transcription and Processing

Transcription factors and machinery, formation of initiation complex, transcription activators and repressors RNA polymerases, capping, elongation and termination, RNA processing, RNA editing, splicing, polyadenylation, structure and function of different types of RNA, RNA transport.

Unit III: Translation and Processing

Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA identity, aminoacyl tRNA synthetase, translational proof-reading, translational inhibitors, posttranslational modification of proteins.

Unit IV: Regulation of Gene Expression

Regulation of phage, viruses, eukaryotic and prokaryotic gene expression, operon concept, co-ordinated control of structural gene, stringent response, positive regulation (Arabinose operon), negative regulation (Lac operon), trp operon, regulation by attenuation.

Unit V: Genetic Exchange: Mapping and Recombination

Molecular mechanism of genetic transfer and mapping genes in – transformation, conjugation, transduction and sexduction. F plasmid, structure and function, origin of Hfr and F' strain; transducing phages, P1, T4, μ, λ. Bacterial transposones, homologous and non-homologous recombination including transposion and side specific recombination. Molecular genetic approaches in bacteria with no natural system.

Immunology 3-1-0=4

Unit I: Introduction: Phylogeny of Immune system, innate and acquired immunity, Clonal nature of immune response. Organisation and structure of lymphoid organs. Nature and Biology of antigens and super antigens.

Unit II: Antibody diversity: Antibody structure and function, antigen and antibody interactions, Major histocompatibility complex, HLA. Generation of antibody diversity and complement system.

Unit III: Cells of immune system: Hematopoiesis and differentiation, lymphocyte trafficking, B-lymphocyte, T-lymphocytes, macrophages, Dentritic cells, natural killer and

lymphokine activated killer cells. Eosinophils, neutrophils and mast cells. Activation of B and T- lymphocytes. Cell mediated cytotoxicity: mechanism of T cell and NK cell mediated lysis, antibody dependent cell mediated cytotoxicity and macrophage mediated cytotoxicity.

Unit IV: Antigen processing: Antigen processing and presentation, generation of humoral and cell mediated immune responses, cytokines and their role in immune regulation, T- cell regulation, MHC- regulation, Immunological tolerance, Hypersensitivity, Autoimmunity, Immonosenesence.

Unit V: Immunological disorders: Transplantation, Immunity to infectious agents (intracellular parasites, helimenths & viruses,) Tumor Immunology, AIDS and other immunodeficiences. Hybridoma Technology and Monoclonal Antibodies.

Unit VI: Antigen - Antibody interactions: Precipitation reactions-Radial immunodiffusion, double immunodiffusion, immunoelectrophoresis; Agglutination reactions-Hemagglutination, passive agglutination, bacterial agglutination, agglutination inhibition.

Unit VII: Complement: The complement components, function, complement activation- (i) Classical, (ii) Alternate and (iii) lectin pathways.

Unit VIII: Hypersensitivity: Definition, types, examples.

Fermentation and Bioprocess Technology 3-1-0=4

Unit I

Introduction to bioprocess technology. Isolation, preservation and improvement of industrially important organisms. Substrates for fermentation processes. Medium optimization

Unit II

Bioreactor design: Laboratory, pilot and large scale reactors. Plug flow reactors, enzyme reactors. Sterilization of media and air. Scale up and Scale down of bioprocess. Mass transfer of oxygen: Agitation and aeration, Determination of KLa, factors affecting KLa, fluid rheology. Inoculum development, aseptic inoculation and sampling.

Unit III

Bioprocess kinetics: Kinetics of growth and substrate utilization in batch, fed batch and continuous systems. Control of process parameters: Instrumentation for monitoring bioreactor and fermentation processes, Sensors, Controllers, fermentation control systems and architecture, Incubation and sequence control, advanced control. Dynamic modeling of fermentation processes.

Unit IV

Downstream processing: introduction, removal of microbial cells and solid matters, foam separation, precipitation, filtration, centrifugation, cell disruption, liquid-liquid extraction, chromatography, membrane process, drying and crystallization, effluent treatment

Unit V: Industrial production of chemicals: alcohols, acids (citric, acetic and gluconic), solvents (glycerols, acetone, butanol), antibiotics (penicillin, streptomycine, tetracycline) amino acids (lysine, glutamic acid), single cell proteins.

Unit VI: Food Biotechnology: Food spoilage and preservation process, dairy products, wine, beer and other alcoholic Beverages and formulated plant products, petro crops, food from water, fungal protein food from yeast, hybrid seeds, conventional breeding of plant for food production. Transformation of steroids and non steroid compounds. Mushroom -types, isolation and culture.

Microbial Physiology and Cell Biology 3-0-0=3

Unit-I: Cell Biology and Bacterial chemolithotrops

Structure and function of cells and intracellular organelles (of both prokaryotes and eukaryotes): Mechanism of cell division including (Mitosis and Meiosis and cell differentiation: Cell-cell Interaction; Physiological groups of chemolithotrops, ammonia oxidation by membrane of Genus Nitro groups, Nitrate oxidation by nitro group of genera. Oxidation of molecular hydrogen by Hydrogenomonas species. Ferrous and sulfur/sulfide oxidation by Thiobacillus species.

Unit-II: Bacterial Photosynthesis

Photosynthetic microorganisms, photosynthetic pigments and generation of reducing power by cyclic and non cyclic photophosphorylation, electron transport chain in photosynthetic Bacteria. Carbon dioxide fixation pathways.

Unit –III: Bacterial respiration

Bacterial aerobic respiration, components of electron transport chain free energy changes and electron transport, Oxidative phosphorylation and theories of ATP formation, inhibition of electron transport chain. Electron transport chain in some heterotrophic and chemolithotrophic bacteria. Bacterial anaerobes respiration: Nitrate, carbonate and sulfate as electron acceptors. Electron transport chain in some anaerobic bacteria. Catalase, super oxide dismutase, mechanism of oxygen toxicity

Unit –IV Bacterial Permeation

Structure and organization of membrane (Glyco-conjugants and proteins in membrane systems), fluid mosaic model of membrane.

Methods to study diffusion of solutes in bacteria, passive diffusion, facilitated diffusion, different mechanisms of active diffusion (Proton Motive Force, PTS, role of permeases in transport, different permeases in E. coli. Transport of aminoacids and inorganic ions in microorganisms and their mechanisms.

Unit – V Bacterial Sporulation

Sporulating bacteria, molecular architecture of spores, induction and stages of sporulation, Influence of different factors on sporulation. Cytological and macromolecular changes during sporulation. Heat resistance and sporulation.

Unit –VI Bacterial Chemolithotrophy

Physiological groups of chemolithotrophs, ammonia oxidation by members of Genus Nitroso group, nitrite oxidation by Nitro group of genera. Oxidation of molecular hydrogen by Hydrogenomonas species. Ferrous and sulfur/sulfide oxidation by Thiobacillus species.

Microbial Molecular Biology and Genetics Lab 0-0-2=3

1. Purification of chromosomal/plasmid DNA and study of DNA profile.
2. Confirmation of nucleic acid by spectral study.
3. DNA denaturation and determination of Tm and G + C contents.
4. Agarose gel electrophoresis of DNA.
5. Effect of UV radiations to study the survival pattern of E.coli /yeast. Repair mechanisms in E.coli / yeast (Dark and Photo reactivation).
6. Isolation of antibiotics resistant mutants by chemical mutagenesis.
7. Ampicillin selection method for isolation of autotrophic mutants.
8. Restriction digestion and Agarose gel electrophoresis of DNA.

Immunology Lab 0-0-2=3

1. Simple immunodiffusion
2. Radial immuodiffusion
3. Immuno-electrophoresis
4. Spot ELISA
5. Blood group and Rh typing
6. Rocket electrophoresis
7. Ag-Ab agglutination reaction

Fermentation and Bioprocess Technology Lab 0-0-2=3

1. Isolation of Industrially important microorganisms for microbial processes.
2. Cultivation and determination of growth curve of bacteria E. coli in batch reactor/flask.
3. Continuous cultivation of bacteria in laboratory (Chemostat)
4. Study of mixed culture and its comparison with the pure culture (growth pattern).
5. Designing of batch bioreactor.
6. Determination of Oxygen Absorption rate as a function of flack size.
7. Determination of Oxygen Absorption rate as a function of RPM on shaker.
8. Determination of KL_a.
9. Fermentative production and recovery of amino acid.

10. Estimation of amino acids.
11. Fermentative production and recovery of industrially important enzymes.
12. Estimation of Alkaline protease.

Semester-III

Recombinant DNA Technology 3-1-0=4

Unit I: Vectors for cloning: Plasmids, phages, ssDNA phages, cosmids,YACs. Enzymes used in gene manipulation-restriction enzymes, DNA polymerases, reverse transcriptase, ligases, polynucleotide kinase, alkaline phosphatase and nucleases.

Unit II: Transfer of DNA into cells: transformation, transduction, electroporation, microinjection. Agrobacterium mediated gene transfer.

Unit III: Cloning strategies: Genomic libraries, cDNA Cloning subcloning, shot gun cloning. Cloning in E. coli, Bacilli and yeast. Yeast two hybrid system. cDNA phage display library. Recombinant clones: Detection of recombinant DNA and its Products.

Unit IV: Site-directed mutagenesis of cloned genes. DNA sequencing: Oxy, deoxy chemical methods, Pyrosequencing, Nanosequencing. PCR: Design of PCR primers, RT-PCR, RACE, AP-PCR, PAF. Antisense and ribosome technology: siRNA, miRNA, Ras, Dicer. Applications of PCR.

Unit V: Applications of genetic engineering: In medicine, agriculture, veterinary and industry. Safety aspects of recombinant DNA technology; Intellectual property rights (IPR) and patents. DNA forensics. Somatic cell gene therapy.

Medical Microbiology 3-1-0=4

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, 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 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.

Bioinformatics and C Programming 3-1-0=4

Unit I: Introduction to Computer: Scope of computers in current biological research. Basic operations, architecture of computer. Introduction of digital computers. Organization, low level and high level languages, binary number system. The soft side of the computer – Different operating systems – Windows, Linux. Introduction of programming in C. Introduction to Internet and its applications.

Unit II: Introduction to Bioinformatics: Genomics and Proteomics. Bioinformatics – Online tools and offline tools. Biological databases. Types of data bases – Gen bank, Swiss port, EMBL, NCBL, and PDB. Database searching using BLAST and FASTA.

Unit III: Multiple sequence alignment and Dynamic programming: Gene and Genome annotation – Tools used. Physical map of genomes. Molecular phylogeny - Concept methods of tree construction.

Unit IV: Protein secondary structure prediction: Protein 3D structure prediction. Protein docking. Introduction to homology modeling, Computer Aided Drug Design (CADD) in Drug discovery.

Biostatistics 3-0-0=4

Unit I: Random Experiment, Outcome, Event, Mutually exclusive events, Equality like and exhaustive, Classical definition of probability, conditional probability and statistical independence. Sequencial definition of probability. Baye's theorem and related problems. Axiomatic approach of probability. Exercise.

Unit II: Random variable. Probability space .Expectation. Theorems on Expectation. Joint distribution of two random variables.

Unit III: Probability distribution- Continuous and Discrete. Probability Density function. Probability Mass function. Binomial , Poisson, Normal and Rectangular distributions and their properties.

Unit IV: Elements of Statistical methods. Primary data and secondary data. Population and sample. Sample survey. Chart and diagram. Frequency distribution. Measure of central Tendencies- Mean , Median and Mode. Standard Deviation, Varience. Moment , Skewness and Kurtosis.

Unit V: Sampling distribution. Fundamental distributions- Standard normal distribution, Chi- square Distribution.

Unit VI: Bivariate Frequency Distribution. Correlation and Co-efficient. Regression lines. Curve fittings.

Recombinant DNA Technology Lab 0-0-2=3

1. UV mutagenesis and percent survival
2. Photoreactivation of UV irradiated E. coli.
3. Development of auxotrophic mutants employing EMS
4. Screening of multiple antibiotic resistant mutants of E. coli
5. Plasmid curing in bacteria
6. Replica plating technique
7. Determination of purity and estimation of DNA
8. Transfection by single burst experiment
9. Blue and white colony selection employing X-gal-IPTG

C Programming Lab 0-0-2=3

Determined by computer Science Department

Semester IV

Food and Industrial Microbiology 3-1-0=4

UNIT-I: An introduction to fermentation processes – the range of fermentation processes. Microorganisms used in industrial microbiological processes – the 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 fermentor: Construction and maintenance of aseptic conditions. Control of various parameters. Sterilization of media. Types of fermentors. Computer application in fermentation technology. Recovery and purification of fermentation products. Fermentation Economics.

Unit III: 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. Microbial contamination of food, food poisoning- microbial agents, food borne illness & poisoning.

Unit IV: Food preservation- Heat processing, low temperature processing, irradiation, high pressure processing, canning, chemical preservation, modification of atmosphere merits and demerits. Biological preservation of Food, Bacteriocin (colicin, radiobacterin, lantibioticsnisine).

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

UNIT-VI: 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.

Environmental Microbiology 3-1-0=4

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.

Soil, Aquatic and Agricultural Microbiology 3-1-0=4

UNIT I: Soil Microbiology – Classification of soil-physical and chemical characteristics, soil as a habitat for micro-organisms, microflora of various soil types, Rhizosphere and rhizoplane. Nitrogen fixation: Asymbiotic and symbiotic nitrogen fixation systems – root nodulation symbiotic bacteria (process of root nodule formation), Leghemoglobulin. Microbial interactionssymbiosis, mutualism, commensalisms, amensalism, competition, antibiosis;Actinorrhiza; Mycorrhizal fungi and its effect on plants.

UNIT II: Aquatic Microbiology – Water ecosystems – types, fresh water (pond, lakes), marine habitats (estuaries, deep sea, hydrothermal vents); Eutrophication, food chain; potability of water, microbial assessment for water quality, water purification, physical, chemical, microbiological characteristics of sewage. Characterization of solid and liquid wastes, physical, chemical and biological (aerobic, anaerobic – primary, secondary, tertiary) treatment; Solid waste treatment; Liquid waste treatment – trickling, activated sludge, oxidation ponds. Formation of biofilm. Biomagnifications

UNIT III: Agricultural Microbiology:

Microbial biofertilizer, types and microbes used, characteristics of inoculants production, production of inoculant biomass, formulation & packaging technology, application of microbial inoculant, PGPR (plant growth promoting bacteria of rhizosphere).

UNIT IV: Microbial insecticides- types, microbes used production of inoculants and application.

UNIT V: Host-parasite interaction. Important diseases in agricultural crops by bacteria (crown gall), viruses (CaMV) and fungi (rust of wheat) and their control (chemical & biological). Microbial diseases of aquacultural animals- finfish and shell fish.

UNIT VI: Plant-Microbe interaction: molecular mechanism of disease development (enzyme, toxin, hormonal disturbances). Resistance by hosts- anatomical & biochemical mechanisms. Role of phytoalexins, PR proteins; control of diseases (chemical, physical, biological & biotechnological).