डॉ0 शकुन्तला मिश्रा राष्ट्रीय पुनर्वास विश्वविद्यालय, लखनऊ।
Dr. Shakuntala Misra National Rehabilitation University,Lucknow.
उत्तर प्रदेश सरकार

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// सूचना //

विश्वविद्यालय द्वारा प्रकाशित विज्ञापन सं0–56/2023 द्वारा विज्ञान संकाय के अन्तर्गत संचालित माइक्रोबायोलॉजी विभाग हेतु विज्ञापित पदों के सापेक्ष असिस्टेण्ट प्रोफेसर के पद हेतु यथाशीघ्र ही लिखित परीक्षा का आयोजन किया जायेगा, जिससे सम्बन्धित निर्धारित पाठ्यचर्या (Syllabus) विश्वविद्यालय की वेबसाइट पर उपलब्ध है।

(रोहित सिंह)
कुलसचिव

पृष्ठांकन संख्या व तद्दिनांक उपरोक्तानुसार।
प्रतिलिपिः वैयक्तिक सहायक, कुलपति को मा0 कुलपति महोदय के अवलोकनार्थ।

(रोहित सिंह)
कुलसचिव

Dr. Shakuntala Misra National Rehabilitation University, Lucknow

डॉ0 शकुन्तला मिश्रा राष्ट्रीय पुनर्वास विश्वविद्यालय, लखनऊ

Syllabus for Written Examination for Recruitment of Assistant Professor 2025

सहायक आचार्य 2025 की भर्ती के लिए लिखित परीक्षा का पाठ्यक्रम

Subject: MICROBIOLOGY

General Microbiology

Unit I: History and scope of microbiology:

History of microbiology, scope and relevance of microbiology in current scenario.

Unit II: Classification and morphology of bacteria:

Classification of microbes (three kingdom, five kingdom, eight kingdom and three domain concept), numerical and molecular taxonomy, introduction to the Bergey's manual of determinative bacteriology; general characters of major groups of eubacteria. Morphology of bacteria (cell, size, shape, cell membrane, flagella, pili and capsule), structure, function and chemical composition of bacterial cell wall.

Unit III: Classification and morphology of Archaea:

Classification of Archaea, general characteristics of *Methanobacterium*, *Methanococcus*, *Methanomicrobium*, *Methanosarcina*, *Halobacterium* and *Thermococcus*; adaptations and role of Archaea in the evolution of microbial world and its cell wall structure.

Unit IV: Cultivation techniques of bacteria:

Concept of Microbial Growth and nutritional requirements. Preparation and types of culture media (synthetic, enriched, selective, differential, indicator media), preservation and maintenance techniques of pure culture. Physical and chemical factors affecting microbial growth.

Unit V: Classification, structure and life cycle of viruses:

General characters of viruses; morphology, capsid and their arrangement, nomenclature and classification. Cultivation of viruses: animal inoculation, embryonated eggs, cell culture. Bacteriophages; structure and life cycle patterns of lytic phages-T_7 and T_4, lysogenic phages-λ & P1; M13 & φX 174, structure of cyanophages and mycophage. Recombination and genome mapping in viruses

Instrumentation and Modern Analytical Techniques

Unit I: Microscopy:

Microscopy; light, dark field, phase-contrast, epifluorescence, confocal and Electron Microscopy (TEM and SEM), fixation techniques for EM. Micrometry.

Unit II: Staining and sterilization procedures:

Basic principles and applications of staining: specimen preparation, simple, gram, capsule, flagella, endospore, acid-fast, fluorochrome and nucleic acid staining. Principle of sterilization techniques (physical and chemical methods), evaluation of antimicrobial agent

effectiveness. Principle and method of sterilization by instruments (Hot air oven, Autoclave), BOD incubator, Laminar Air Flow and Biosafety cabinets.

Unit III: Chromatography:

Principles and applications of chromatography (partition and adsorption), paper, thin-layer, column, size exclusion, ion exchange, affinity chromatography, GLC, HPLC and FPLC.

Unit IV: Spectrophotometry:

Interaction of radiation with matter, α, β, γ- rays; absorption (Beer-Lambert's law) and emission. Principle and application of spectrophotometry; UV-visible, IR, fluorescence, NMR, ORD/CD, flow cytometry, X-ray crystallography.

Unit V: Miscellaneous techniques:

Principles and applications of electrophoresis: agarose gel electrophoresis, SDS- and native PAGE, isoelectric focusing, 2D-gel electrophoresis. Centrifugation; ultracentrifugation, differential centrifugation. Dialysis, ultrafiltration.

Bioinformatics, Biostatistics and IPR

Unit I: Basic concept of bioinformatics:

Generations of computer hardware and software; number system, translators (compiler & interpreter), Introduction of Bioinformatics and applications. Information network: web browser and address (GeneBank and Biological databases; NCBI, DDBJ, EMBL, TIGR and PDB etc), BLAST, FASTA file format, sequence alignment

Unit II: Application of bioinformatics in microbiology:

Databases: information resources for protein and genomics, alignment, phylogenetic analysis; phylogenetic software (MEGA 11.0), fundamental of phylogenetic tree building and evaluation, interpretation-paralogues and orthologues.

Unit III: Introduction to statistics:

Range, Mean, median, mode, standard deviation, Probability distribution, Chi-square test, 't' and 'f' test, analysis of variance, standard error, linear regression, Sample, Population and sampling methods.

Unit IV: Intellectual property concept:

Intellectual Property Rights (IPR), Patents, Trademarks, Copyrights. Introduction to Patenting of Microbiological materials and GMO, implication of patenting, current issues, patenting of genes and DNA sequences.

Unit V: Project and research article drafting:

Concept and plagiarism and structure of project report (Introduction, review of literature, Material and Methods, Results, Discussion, Summary, Conclusion and Reference).

Immunology

Unit I: Basics of immune system:

Overview of the immune system, innate and adaptive immune system, humoral and cell-mediated immune responses, cells and organs of immune system involved in innate and adaptive immunity, primary and secondary lymphoid organs, antigens, structure and function of antibody molecules, antibody classes and biological activities, heptanes, adjuvants, antigenicity and immunogenicity, factors that influence immunogenicity, antigenic determinants on immunoglobulin (isotype, allotype and idiotype).

Unit II: Antibody diversity and engineering:

B and T cell epitopes, generation of antibody diversity, monoclonal antibodies, antibody engineering.

Unit III: Antigen processing and presentation:

Antigen-antibody interactions, antigen processing and presentation, maturation, activation and differentiation of B and T cells, B and T cell receptors, toll-like receptors, natural killer cell, antigen-presenting cell, cytokines, interleukins, interferons.

Unit IV: MHC, complement system and hypersensitivity:

Major histocompatibility complex (MHC), complement system, hypersensitivity (IgE mediated, antibody mediated, immune complex mediated and delayed type).

Unit V: Principles of Immuno-techniques:

Strength of antigen-antibody interaction; precipitation reaction, agglutination reactions, radioimmunoassay, enzyme linked immunosorbent assay, western blot, autoimmunity, vaccines, AIDS and HIV.

Food Quality Testing

Unit I: Food adulterants:

Microbiological and chemical examination of common food adulterants in wheat, flour, sugar, turmeric, grounded coriander, salt, vegetables oils, ghee, honey etc.

Unit II: Microbial analysis of fruits and vegetables:

Microbiological examination of seasonal fruits and vegetables and the common disease caused by infected fruits and vegetables.

Unit III: Microbial analysis of milk and milk products:

Milk and milk products- quality testing, chemical and microbiological analysis, common disease caused by infected milk and milk products- their prevention and cure.

Unit IV: Microbial analysis of stored and frozen food and beverages:

Microbiological and chemical examination of low temperature stored food and beverages, frozen vegetables, pizza, soya cheese, ice- cream, frozen yoghurt, frozen soup, soft drinks.

Unit V: Food preservatives:

Common food preservatives and their effect on human health.

Health and Hygiene

Unit I: Introduction to health and hygiene:

Individual health parameters, Determinants of Health, Key health indicators, Burden of diseases, Importance and Source of Public-health Data Health status in India: Standards, Relevance to social aspects, Future challenges in public health.

Unit II: Public health and nutrition:

Personal health, Food safety quality control and hygiene: Personal and domestic Hygiene. Classification of nutritional profiles of various foods and drinks, Balanced Diet, Nutritional Problems, Demography and Family Planning.

Unit III: Role of Public, Private and NGO in health sector:

Expenditure in Healthcare, Government Plans and Policies in India, The Global Health Council, The International AIDS Vaccine Initiative, Malaria Vaccine Initiative, World Health Organization (WHO).

Unit IV: Community diseases, prevention and control:

Common Community Diseases like: Chikungunya, Dengue, Malaria, Cholera, T.B., HIV/AIDS, Hepatitis: Their prevention and control.

Unit V: Epidemic diseases:

Epidemiology and history of epidemiological diseases in India with special reference to COVID-19, Route of Transmission of Disease, Communicable and Noncommunicable diseases.

Medical Microbiology

Unit I: Introduction of medical microbiology:

Normal flora of human body (skin, oral and gut), clinical sample collection and serological testing for important pathogens (bacterial, viral and fungal),

Unit II: Bacterial diseases:

Important human bacterial diseases caused by *Staphylococcus, Pneumococcus, Neisseria, Bacillus, Corynebacterium, Clostridium, Pseudomonas, Yersinia, Haemophilus, Mycobacterium, Nocardia, Klebseilla, Salmonella, Shigella.*

Unit III: Fungal diseases:

Phycomycosis; Candidiasis, *Fusarium, Cryptococcus, Pneumocystis,* Dermatophytosis; Aspergillosis; Otomycosis, Cutaneous and subcutaneous mycoses; Zygomycoses, *Histoplasma,* Blastomyces, *Coccodioides,* Systemic mycoses; *Trichophyton, Microsporum, Epidermophyton* Opportunistic mycoses; *Rhizopus, Rhizomucor, Absidia.* Antifungal agents and susceptibility test.

Unit IV: Protozoan diseases:

Malaria, sleeping sickness, amoebiasis, leishmaniasis, Giardiasis.

Unit V: Viral diseases:

Algorithms for detection and identification of viruses; Mumps, Measles, Influenza, Adenovirus, Enterovirus, Rhinovirus, Poxvirus, Hepatitis A, B, C, D and G virus, rabies virus, polyoma viruses, Epstein Barr virus, Herpes virus, HIV, Varicella zoster virus, tumour viruses and Japanese encephalitis virus (JEV). Antiviral agents and susceptibility test.

Microbial Physiology and Biochemistry

Unit I: Basics of biochemistry and function of biomembrane:

Stabilizing interactions; Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction etc. structure of model membrane (lipid bilayer and membrane protein diffusion, osmosis, ion channels, facilitated diffusion, primary and secondary active and passive transport, membrane pumps). pH and buffers.

Unit II: Structural composition, function and metabolism of amino acid and protein:

Proteins (amino acid, peptide bond, pathway of amino acid biosynthesis and degradation, human genetic disorder affecting amino acid catabolism, primary, secondary, tertiary and quaternary structure, Ramchandran plot, protein folding).

Unit III: Structural composition, function and metabolism of carbohydrate and lipids:

Carbohydrates (mono, di and polysaccharides), glycogenolysis, gluconeogenesis; lipid (lipid transport, cholesterol synthesis, fatty acid synthesis, β-oxidation, Ketogenesis).

Unit IV: Structural composition, function and metabolism of nucleic acid and vitamins:

Nucleic acids (different form of DNA, biosynthesis and degradation of nucleotides) and vitamins.

Unit V: Enzyme kinetics and bioenergetics:

Classification, Michaelis-Menton kinetics, enzyme inhibition (competitive, uncompetitive, non-competitive and mixed); enzyme regulation, mechanism of enzyme catalysis, isozymes, ribozyme, energy production in cell, ATP generation, glycolysis, shuttle system. TCA cycle, pentose phosphate pathway, urea cycle, glyoxylate cycle, electron transport chain (respiratory chain), oxidative and substrate level phosphorylation, bacterial photosynthesis.

Industrial Microbiology

Unit I: Sources and characters of industrially potent microbes:

Isolation, purification and maintenance of industrially potent microbes. Screening of useful strains: primary and secondary screening. Strain improvement through random mutation, genetic recombination and genetic engineering. Microbial growth kinetics in batch, continuous and fed-batch fermentation.

Unit II: Bioreactor:

Basic principle and architecture and design of bioreactor (stirred tank, trickling filter, packed, air lift and photo bioreactor), raw materials used in fermentation media. Solid state fermentation and submerged fermentation: their advantages and disadvantages.

Unit III: Commercial production of antibiotics:

Microbial transformations with special reference to steroids and alkaloids. Primary and secondary metabolites. Upstream and downstream processing of microbial products, commercial production of antibiotics with special reference to penicillin, streptomycin and their derivatives.

Unit IV: Microbial production of beverages and acids:

Malt beverages, distilled beverages, wine and champagne. Commercial production of organic acids (acetic, lactic, citric and gluconic acids).

Unit V: Commercial production of amino acid, insulin and vitamins:

Commercial production of important amino acids (glutamic acid, lysine and tryptophan), production of recombinant products (insulin) and vitamins (vitamin B12, riboflavin and vitamin A).

Nutritional Therapy

Unit I: Basics of nutritional requirements:

Nutrition and Nutritional requirements in human, Artificial nutrition & types, Functional foods & types, Therapeutic nutrition, Nutritional supplements, Prebiotics & Probiotics Neutraceuticals.

Unit II: Importance of microbes in food:

Food for human: use of microbes and microbial enzymes in the improvement of nutritive quality of food, Microbiological criteria for food, Fruit juices, Food control.

Unit III: Therapeutic nutrition and management for allergies:
Therapeutic nutrition in Nausea, constipation, Weight loss & Swallowing problems, Allergies, Food born allergies, Diagnosis and intolerance, Dietary management of food allergies, Pea nut allergy, Cow milk allergy.

Unit IV: Therapeutic nutrition and management for cancer, digestive and metabolic disorder:
Cancer, Cancer causing dietary factors, Therapeutic nutrition and dietary management, Diets and Digestive disorders, Metabolic conditions of liver & Gallbladder; Hepatitis, Cirrhosis.

Unit V: Therapeutic nutrition and management for diabetes, obesity and renal dysfunction:
Diabetes &Diabetes types, complications, Therapeutic nutrition & management of diabetes, Fat and Cholesterol, Renal dysfunction, stones, Therapeutic nutrition & treatment.

Lab Diagnosis

Unit I: Clinical sampling, identification and staining of microbes:
Collection, transport and storage of clinical specimens; Prevention and control of laboratory acquired infections; Identification of Microorganisms; Different staining techniques: Gram's staining, Ziehl-Neelsen method for AFB, Flurochrome staining, Giemsa's staining and special staining methods to demonstrate granules, capsule and endospores.

Unit II: Clinical pathology:
Physical, chemical and microbiological examination of urine, stool, CSF and blood culture; Semen analysis; Pregnancy test.

Unit III: Laboratory diagnosis of diseases:
Laboratory diagnosis of Diarrhoea, sore-throat, pyrexia, sexually transmitted disease, Urinary tract infection, Respiratory tract infection.

Unit IV: Haematological diagnosis:
Blood collection: venipuncture; White blood cells (WBC), Red blood cells (RBC) count and Platelet count; Haemoglobin estimation; Staining and Differential Leucocyte Count (DLC); Erythrocyte Sedimentation Rate (ESR), Haematocrit and Absolute values; Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH), Mean Corpuscular Haemoglobin Concentration (MCHC); Blood grouping.

Unit V: Infection in clinical practices:
Infections of the Skin and Tissues, Central nervous system, Eye and surrounding structure, Bone and Joints, Congenital and Neonatal infections, Hospital patient's infections, Immunocompromised patient's infections.

Food Microbiology and Toxicology

Unit I: History and scope of food microbiology:
Food microbiology: brief history, scope and microbial diversity of foods; microbes involved in spoilage of food, meat, poultry, vegetables and dairy products; food preservation.

Unit II: Role of microbes in milk and dairy products:
Microbiological examination of milk, standard plate count, direct microscopic count and reductase test, composition of milk, sources of contamination of milk, type of microbes in milk,

pasteurization of milk, ability of milk to cause disease; manufacturing of cheeses, butter, yoghurt and fermented milk.

Unit III: Role of microbial enzyme in food:

Microbial enzymes in food; low calorie sweeteners, flavour modifiers, food additives, food quality monitoring.

Unit IV: Role of microbes in food spoilage:

Food spoilage, antimicrobial compounds of foods, lactose-peroxidase system, microbial deteriorations of cereals, pulses, fish and sea-foods during storage.

Unit V: Role of microbial toxin in food:

Introduction to toxins and toxoids, bacterial and mycotoxins, chemical nature of important toxins and their role in food poisoning, physiology and mechanism of action, modification and methods of detoxifications; prevention and control of toxin contamination.

Pharmaceutical Microbiology

Unit I: General characteristics and mode of action of antimicrobial drugs:

General characteristics and mechanism of action of antimicrobial drugs, Factors influencing antimicrobial drug effectiveness, Antibiotics and synthetic antimicrobial agents: Aminoglycosides, β- lactams, tetracyclines, annamycin's, antifungal antibiotics, antitumor substances; peptide antibiotics, Chloramphenicol, sulpha drugs.

Unit II: Action mechanism of antibiotics:

Penicillin, vancomycin (cell wall synthesis inhibition); aminoglycosides, tetracycline, chloramphenicol (protein synthesis inhibition); Rifampin, quinolones and fluoroquinolones (nucleic acid synthesis inhibition); polymyxin B (cell membrane disruption).

Unit III: Microbial contamination and spoilage of pharmaceuticals products:

Sterile injectables, noninjectable and their sterilization; Manufacturing procedures and in process control of pharmaceuticals. Use of microbial enzymes in pharmaceuticals, biosensors.

Unit IV: Drug delivery system in gene therapy

Molecular principles of drug targeting, drug delivery system in gene therapy, Mode of action of non-antibiotic antimicrobial agents; Penetrating defenses- how the antimicrobial agents reach the targets, cellular permeability barrier, cellular transport system and drug diffusion.

Unit V: Quality assurance and quality management:

Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP) and in pharmaceutical industry, regulatory aspects of quality control, Quality assurance and quality management in pharmaceuticals ISO, WHO and US certification.

Molecular Microbiology

Unit I: DNA replication and repair mechanism:

DNA replication in prokaryotes and eukaryotes; enzymes involved, replication unit, origin of replication and replication mechanism. Types of DNA polymerase in prokaryotes and eukaryotes, inhibitors of DNA synthesis, DNA damage and repair mechanisms.

Unit II: Mechanism of RNA synthesis and processing:

Structure and function of different types of RNA, different types of RNA polymerases (I, II & III), RNA editing, splicing and polyadenylation, transcription in prokaryotes and eukaryotes, inhibitors of RNA synthesis, genetic code.,

Unit III: Mechanism of Protein synthesis and modification:
protein synthesis in prokaryotes and eukaryotes, aminoacylation of tRNA, formation of initiation complex, initiation factors, elongation factors, termination, translational inhibitors, post-translational modification of proteins.

Unit IV: Regulation of gene expression:
Control of gene expression at transcription and translation level, operon concept, negative and positive regulation, inducers and co repressors, catabolite repression.

Unit V: Molecular mechanism of signal transduction
Biosignaling; molecular mechanism of signal transduction, mode of cell-cell signalling, G protein-coupled receptor, protein tyrosine kinase receptor, second messengers, signalling in development and differentiation, apoptosis.

Recombinant DNA Technology

Unit I: Basics of r-DNA technology:
Introduction and History of RDT, Enzymes used in r-DNA technology; DNA ligase, DNA polymerase, Klenow fragment, reverse transcriptase, exonuclease, endonuclease, terminal deoxynucleotidyl transferase, alkaline phosphatase, polynucleotide kinase and dephosphatases; restriction modification systems and their types; sticky and blunt end ligation, joining with linkers, adapters & homopolymer tailing.

Unit II: PCR and DNA fingerprinting technology:
PCR its various schemes and applications (Basic PCR, inverse-PCR, multiplex-PCR, RT-PCR, anchored-PCR, asymmetric-PCR, real time-PCR); DNA sequencing methods: dideoxy and chemical method, automated sequencing and pyrosequencing, strategies for sequencing large DNA fragments (Shot gun approach); non-radioactive & radioactive labelling of probes; RFLP, AFLP, RAPD, DGGE, ARDRA, microarray.

Unit III: Cloning vectors and host:
General properties, plasmids, Fosmids, bacteriophages, cosmids, shuttle vectors, bacterial artificial chromosomes. Eukaryotic cloning vectors for yeast (YIp, YEp, YCp, YAC), higher plants (Ti based vectors, binary and cointegrate, chloroplast-based vectors) & for animal cells (SV 40, vaccinia, retroviruses).

Unit IV: Cloning and hybridization technique:
Selection of recombinant clones: colony hybridization, plaque hybridization, immunochemical methods, southern blotting and northern blotting. Isolation and purification of genomic and plasmid DNA. Gene libraries: genomic library, screening of libraries, cDNA library (different methods for synthesizing cDNA molecules).

Unit V: Expression vectors for expressing foreign genes in *E. coli*:
Problems associated with the production of r-proteins in *E. coli*, production of r-protein by eukaryotic cells. Applications of gene technology: production of pharmaceuticals- humulin, somatotropin, somatostatin, recombinant vaccines. Bt-cotton, 'Flavr Savr' tomato and golden rice.

Epidemiology

Unit I: History, development and scope:
History of epidemiology, basic vocabulary and processes used in the science of epidemiology, routes of transmission of disease, non-communicable and communicable

infection, microorganism responsible for nosocomial infection, epidemiology of nosocomial infection.

Unit II: Health and disease:

Basic Concepts and Definition, Disease Control and Levels of Prevention, Determinants and Indicators of Health, Health situation and Trends in India. Genesis and Development of the concept, Healthcare versus Medical Care.

Unit III: Infectious notifiable diseases and prevention

Studies of infectious notifiable diseases as COVID-19, AIDS, Plague, anthrax, botulism, cholera, gonorrhoea, hepatitis, rabies, syphilis, tetanus, tuberculosis, typhoid, with their sign, symptoms, diagnostic test, chemotherapy and vaccines availability.

Unit IV: Nutrition and health:

Classification and Nutritional profiles of various foods and drinks, Balanced diet, Diet survey, consumption unit, nutritional classification, Nutritional problems e.g. LBW, PEM, Xerophthalmia, IDD, etc. Nutritional factors in selected/ major diseases (Cardiovascular, Diabetes, Obesity, Cancer)

Unit V: Environment and health:

Environmental degradation and human pathology, Examination of living/ working environment & its impact on human health; Industrial and Occupational Health: Industrial and Occupational hazards and accidents, Occupational diseases and their prevention. Right to a safe Biosphere.

Food and Water Borne Disease

Unit I: Food borne diseases:

Classification of food borne diseases, Food poisoning, Infection and intoxication, Nonbacterial toxins and mycotoxins, sea food toxin, Poisoning by chemicals.

Unit II: Food and water borne bacterial and viral diseases:

Major food and water borne bacteria *S. aureus, Pseudomonas, Clostridium, Bacillus, Vibrio, E. coli, Salmonella, Shigella*, Major food and water borne Viruses- Polio virus, Rotavirus, SARS, Enterovirus.

Unit III: Detection and prevention of food contaminants:

Rapid methods for detecting microbial contaminants in foods, Interpretation and application of result and preventive measure.

Unit IV: Disease management of food borne disease:

Irradiation replaces other food borne disease, microbiological aspect of food, transmission, symptoms, diagnosis, treatment, prevention of disease, Surveillance system for tracking food borne disease.

Unit V: Water contaminants and quality analysis:

Natural waters: Sources of contamination, Microbial indicators of fecal pollution and other pollution, IMViC test and Water quality test.

Microbial Genetics

Unit I: Prokaryotic gene structure:

The rII locus, complementation test, cistron, recon, muton, diversity of phage genomes, Life cycle of Bacteriophages (Lytic and Lysogenic), linkage and crossing over.

Unit II: Mutation and mutagens:

Spontaneous, induced, intragenic and intergenic mutation, mutagenesis, mutagens (physical and chemical mutagens; non ionizing radiation; base analogues, alkylating agents, deaminating agents, intercalating agents & others), molecular mechanism of mutagens. Detection and isolation of mutants. DNA damage and repair mechanisms.

Unit III: Recombination and Gene mapping:

Reciprocal and non-reciprocal, mechanism of recombination; Holiday model, Fox model, enzymatic mechanism of recombination, transposable element (classes and nomenclature); IS elements, transposons (composite structure and complex transposon's structure) mechanism of transposition, gene mapping.

Unit IV: Gene transfer mechanism:

Bacterial transformation (mechanism of transformation, transfection, competence), transduction; generalized transduction, specialized transduction, abortive transduction, conjugation; effective contact and Pilli in conjugation, the role of F- plasmid 'F' factor, the conjugal transfer process, high frequency recombination (Hfr) strains, the order of chromosome transfer, formation of F prime (F'). Methods of gene mapping in microbes.

Unit V: Plasmids:

F-, R-, Col- and Ti plasmid; control of copy no. and incompatibility. Bacteriophages; lytic phages-T7 and T4, lysogenic phage- λ and P1; M13 and $\phi \times 174$; recombination and gene mapping in viruses.

Environmental Microbiology

Unit I: Microbes in extreme environments:

Environment induced genetic and physiological adaptations in microbes; characteristic features of thermophiles, psychrophiles, methanogens, methylotrophs, acidophiles, alkaliphiles, halophiles and their survival strategies.

Unit II: Biogeochemical cycling:

Microbes in nutrient cycling with special reference to carbon, phosphorous, sulphur and nitrogen cycles.

Unit III: Biodeterioration:

Biodeterioration of properties & cultural heritage; microbial deterioration of paper, textile, wood, paint and metal corrosion. Methods for their protection.

Unit IV: Biodegradation and Bioremediation:

Microbial degradation of lignocellulosic substances, keratin and chitin and xenobiotics; microbial degradation of pesticides; hydrocarbons; clean-up of sites polluted with oil spills, heavy metals and chlorinated solvents; biological treatment of effluents of sugar, pulp and paper industry. Recovery of minerals and metals from ores.

Unit V: a. Techniques in environmental microbiology:

Methods for determination of numbers, biomass and activities of microbes in soil, water, air and on plant surfaces and dead organic materials.

b. Microbes in waste disposal:

Microbes in solid waste and sewage treatment systems. Disinfection of potable water supplies; bacterial indicators of water safety; microbial assessment of water quality; standards for tolerable levels of faecal contamination.

Modern Immunological Techniques

Unit I: History and principle of Immuno-techniques:

History and principle of immuno-techniques; agglutination: direct and indirect, immuno-electrophoresis, RIA, ELISA, immuno-fluorescence.

Unit II: Methods used in immunology:

Preparation of antigens and antibodies, purification of antibodies, analysis of antibodies and antigens, preparation and uses of various types of vaccines.

Unit III: Techniques used in immunology:

Types of immunodiffusion methods, ELISA, RIA, Western blot analysis, Electrophoresis and Hybridization techniques, immunohistochemistry, Immunoflowcytometry, Immunofluoroscence, Lateral flow immune assay, Heterologous and homologous immunoassay.

Unit IV: Clinical immunotechniques:

Applications of antisera in the detection of various diseases, like syphilis and lyme, typhoid, streptococci infections, HIV, various types of Hepatitis.

Unit V: Antibody engineering and immunotherapy:

Antibody engineering, Catalytic antibodies, antibody immunotherapy, productions of drugs to allergies.

Agricultural Microbiology

Unit I: Development and scope of agricultural microbiology:

History, development and scope of agricultural microbiology.

Unit II: Introduction to soil microbiology:

Formation and composition of soil organic matter; physio chemical properties of soil. Microbiota in different soil profile, microbiological methods of evaluation of soil fertility.

Unit III: Biofertilizers and soil:

Biocontrol agents/biopesticides (bacteria, fungi, viruses and nematodes), biofertilizer; production, formulation and application, composting, vermicomposting, Mycorrhiza (VAM), Actinorhiza, Entomo Pathogenic Nematodes (EPN).

Unit IV: PGPR and mushroom cultivation:

Rhizosphere, biofertilizers, concept of plant growth promoting rhizobacteria (PGPR) and their mode of action, single cell protein, mushroom cultivation.

Unit V: Plant diseases:

Late blight of potato, downy mildew of pea, stem gall of coriander, powdery mildew/ smut/ rust of linseed, ergot of pearl millet, anthracnose of soybean, tikka disease of groundnut, wilt of pigeon pea, blight (fungal and bacterial), citrus canker, leaf curl of papaya, little leaf of brinjal, nematode disease of agri-crops (root-knot nematode, root lesion nematode, reniform nematode).

Food Safety

Unit I: Introduction to food safety:

Hazards to safe food (chemical, biological, physical hazards), contamination and spoilage, food hygiene, food itself, safety of food, sources of contamination, food quality, food safety challenges, reducing the effect of contamination; Role of food processing industries and sector.

Unit II: History of HACCP, health and hygiene:

History, back ground and structure of HACCP, Food chain steps, benefits and barriers in implementing HACCP, HACCP prerequisites and good hygiene practice, Environmental hygiene, design and facilities in the establishment, equipment, utilities, personal health and hygiene, pest control.

Unit III: HACCP principles and application guidelines:

Determination of critical control points, establishing the critical limits, Establishment of corrective action, establishment of verification procedure, establish documentation and record keeping, validation, general errors in HACCP plan, Quantitative approach in HACCP , implement of HACCP Plan, case studies of HACCP.

Unit IV: Risk analysis and management:

Introduction to risk analysis, risk management, Risk assessment, and Risk communication. Detection of various methods of food toxicity, Hazard analysis and criteria control points (HACCP) system for food safety, Food Safety and Standards Authority of India (FSSAI), Food quality protection act (FQPA)

Unit V: Other food safety practices:

Good Agriculture practices, good animal husbandry practices, good manufacturing practices, good retail practices, good transport practices, nutritional labeling, Traceability studies.

Virology

Unit I: Origin and development of concept of virology:

Collection of clinical samples; Cultivation of Viruses, Diagnostic techniques for viral diseases. Virus identification: Immunofluorescence, Immunoperoxidase test, Neutralization, Light microscopy and Electron microscopy, replication strategies of representative viruses from the seven Baltimore classes

Unit II: Nature of viral zoonoses:

Rabies, Haemorrhagic fevers, yellow fever, Colorado tick fever, Viral Encephalitis (Japanese encephalitis, Venezuelan equine encephalitis, Eastern and Western equine encephalitis, St. Louis encephalitis, Murray valley encephalitis).

Unit III: Human diseases caused by viruses:

Diseases caused by Coronaviruses (COVID-19) Orthomyxoviruses (Influenza), Paramyxoviruses (Mumps, Measles, Respiratory Syncytial Virus), Picornaviruses (Enteroviruses, Rhinoviruses), Poxviruses, Herpesviruses, Human Retroviruses, Adenovirus, Hepatitis.

Unit IV: Characteristics, classification and diversity of plant viruses:

Plant Viruses with special reference to: Cucumber mosaic virus (CMV), Tobacco mosaic virus (TMV), Papaya ring spot mosaic virus (PMV) Tomato yellow leaf curl virus (TYCLV), Bhindi yellow mosaic vein virus (BYMVV).

Unit V: Prions and Viroid:

Structure, replication and diseases caused by them, Viroid; Emerging and re-emerging diseases.

Food Processing, Preservation and Packaging

Unit I: Common food processing:

Introduction, Classification & Method of Cooking, Baking, Frying, Roasting, Toasting, Grilling, Blanching, and Extrusion

Unit II: Primary processing:

Introduction, Classification & Method of Cleaning, Sorting, Grading, Cutting, Seeding, Chilling and freezing.

Unit III: Secondary processing:

Introduction, Classification & Method of Slicing, Pulping, Paste, Frying, Chilling and freezing, Milling.

Unit IV: Introduction to preservation:

Preservation, types and methods of preservation, natural and artificial preservative agent, class I, II and III preservative agents.

Unit V: Introduction to Food Packaging:

Objectives and functions of food packaging, Requirements for effective food packaging, Types of packaging Materials, General properties of packaging material