

AP RCET- 2021 SYLLABUS

SUBJECT: VIROLOGY

Unit 1: Biochemistry and Analytical tools:

- **Biochemistry:**Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics); Structure of atoms, molecules and chemical bonds; Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins); Basic concepts of metabolism of carbohydrates, lipids, amino acids and nucleic acids; Conformation of proteins and nucleic acids; Enzymes - classification, catalytic and regulatory strategies; Enzyme kinetics - Michaelis-Menten equation; Mechanism of enzyme action; Isozymes and immobilized enzymes; Introduction to hormones and growth regulators and their functions.
- **Analytical tools:** Principles of microscopy - light, electron, fluorescent and confocal microscopy; Principles of spectroscopy - UV, visible, CD, IR, Fluorescence, FT-IR, MS, NMR, X - ray crystallography; Principles of chromatography - paper, thin layer, ion - exchange, gel permeation, affinity, HPLC, MALDI-TOF; Principles of Preparative and analytical centrifugation; Electrophoresis (acrylamide, agarose, 2D-PAGE, pulse - field, capillary); Radioisotopes - autoradiography, molecular imaging, biological effects and applications of radioisotopes; Immunoassays - Principles of ELISA, RIA, Immunohistochemistry, Immunoblotting.

Unit 2: General Microbiology and Virology:

- **General Microbiology:** Recent criteria for classification of microorganisms; Structure and general characteristics of microorganisms; Staining techniques; Cultivation of microorganisms; Bacterial reproduction and growth curve; Sterilization techniques, antibiotics and antimicrobial resistance; Microbiology of water, milk, air, soil and sewage; Microbes as pathological agents in plants and animals; Human diseases of clinical importance caused by bacteria, fungi, protozoa, parasitic helminths (e.g., TB, aspergillosis, malaria, filariasis); Economic importance of algae and fungi.
- **General Virology:** Pioneers of Virology; Criteria used for virus classification (ICTV); Morphology, structure and properties of viruses; Cultivation of viruses - experimental plants and tissue culture, experimental animals, embryonated eggs, organ cultures, primary and secondary cell cultures; Assay of viruses - Infectivity assay methods (plaque, pock, end point, local / systemic assay of plant viruses), physical (EM), serological (HA, HI, immunofluorescence, ELISA) and chemical (viral protein and nucleic acid based) approaches; Transmission of viruses (vector and non-vector); Purification of viruses; Biology of bacteriophages (lambda, T4, M13), cyanophages, mycophages and

phycophages; Biology of sub-viral agents - Satellite viruses, sat - RNAs, viroids and prions.

Unit 3: Cell and Molecular Biology:

- **Cell Biology:** Prokaryotic and eukaryotic cell structure and organelles; Cell-cell communication; Cell signalling and signal transduction; Cell cycle - Mitosis and meiosis and their regulation, cell death, mechanism of apoptosis and its significance; Cell culture - types, composition, media and applications; Cell lines - Definite and continuous cell lines, normal versus transformed cells; Maintenance and preservation of cell lines, large scale production; Stem cells and significance; Cell counting - Detection of molecules in living cells, in situ localization (FISH), haemocytometer, cell viability and cytotoxicity; immunofluorescence, flow cytometry, MTT based assays.
- **Molecular Biology:** Molecular structure of genes and chromosomes; DNA replication, transcription, splicing, translation, post translational modifications and their regulatory mechanisms; Regulation of gene expression (*lac*, *trp* and *gal* operons); Mutations and mutagenesis; Non - coding and micro RNA; RNA interference; DNA damage and repair; Plasmids and transposons; Gene transfer mechanisms and gene mapping in bacteria- Transformation, conjugation, transduction, mapping genes by interrupted mating, homologous and non - homologous recombination.

Unit 4: Recombinant DNA Technology and Immunology:

- **Recombinant DNA technology: A. Tools:** Enzymes - DNA and RNA polymerases, Restriction endonucleases, DNA joining enzymes, nucleases and other nucleic acid modifying enzymes; Vectors - Plasmids, bacteriophage vectors, cosmids, yeast vectors, artificial chromosomes (YACs and BACs), Ti plasmid - based vectors, baculovirus - based vectors, plant and animal virus vectors, shuttle vectors, expression vectors; Oligonucleotides - linkers, adaptors, homopolymer tails, primers, promoters, Ori, marker genes; Source DNA - genomic DNA, cDNA, PCR products and chemically synthesized oligonucleotides; Cloning and expression host systems - bacteria, yeast, insect cells, plants and animal cells; Gene transfer technologies (transformation, electroporation, lipofection, transfection using chemicals, biolistic approaches); cDNA and genomic DNA library; Gene isolation and cloning, strategies for production of recombinant proteins in prokaryotic (*E. coli*) and eukaryotic (yeast, insect cell, plant and animal) systems; transgenic plants and animals.
- **B. Molecular techniques used for gene manipulation:** Polymerase chain reaction; DNA sequencing; Southern and northern blotting, DNA/RNA labelling and hybridization; DNA profiling - DNA fingerprinting, AFLP, RAPD, RFLP; Site - directed mutagenesis; Yeast two hybrid system; Microarray technology; CRISPR - Cas technology.
- **C. Computational tools:** Bioinformatics resources and search tools; Sequence and structure databases; Sequence analysis – sequence file formats, scoring matrices, CLUSTAL W alignment, phylogeny; Genomics, proteomics, metabolomics; Gene prediction; Functional annotation; homology modelling, Secondary structure and 3D structure prediction; Metagenomics; Metabolic engineering and systems Biology.

- **Immunology:** Cells and organs of immune system; Innate and adaptive immunity (humoral and cell mediated response); antigens; Antibody - types, structure and functions; Polyclonal and monoclonal antibody production and applications; *In vivo* (Phagocytosis, Opsonization, Neutralization) and *in vitro* serological reactions [Precipitation tests, Immuno electrophoresis (AGDD, rocket), Agglutination tests - HA & HI, latex agglutination, ELISAs, Radio immunoassay (RIA), Immunofluorescent and Immunosorbent electron microscopy]; Complement activation pathways; Toll - like receptors; Cytokines; Major histocompatibility complex (MHC); Antigen processing and presentation, B-cell and T-cell activation; Hypersensitivity; Immunodeficiency disorders; Autoimmune diseases; Graft versus host reaction; Immunization and vaccines (conventional and modern), vaccine delivery & adjuvants, large scale manufacturing of vaccines, Animal models and vaccine potency testing.

Unit 5: Plant Virology and Virus Diseases:

- **Plant Virology:** Plant virus - host interactions; Cell to cell and long distance movement of viruses in plants; Vector and non - vector transmission of plant viruses, Virus vector relationships; Molecular mechanism of virus-vector interactions; Biological, physical, molecular and immunological approaches used for characterization and detection of viruses and virus strains; Biological and physical factors influencing survival and spread of viruses and virus diseases; mono- and polycyclic diseases; Forecasting of virus diseases; Field surveys for determination of incidence of virus diseases; Management of virus diseases and production of virus resistant plants.
- **Plant Virus Diseases:** (Emphasis shall be given to disease distribution, incidence and impact, symptoms, causal virus characteristics, diagnosis, disease cycle and management) - Rice tungro disease; Maize streak disease, Groundnut bud necrosis disease; Coconut Cadangcadang viroid disease; Tomato yellow leaf curl disease; Tomato spotted wilt disease; mosaic disease caused by CMV on Chilli; Potato leaf roll disease; Potato spindle tuber viroid disease; Fizi Disease on sugarcane; Cassava mosaic disease; Pea seed - borne mosaic disease, Pegionpea sterility mosaic disease; Banana bunchy top disease; Citrus tristeza disease; Grapevine fan leaf disease; Sugarbeet curly top yellows disease; Cotton leaf curl disease; Tobacco mosaic disease; Tobacco streak disease on vegetable crops; Cocoa swollen shoot disease; Tulip flower breaking disease; Chrysanthemum stunt viroid disease.

Unit 6: Molecular and Tumor Virology:

- **Molecular Virology:** Molecular architecture of icosahedral and helical viruses; Molecular mode of virus inactivating agents (physical and chemical agents); Structure and diversity of virus genomes; Expression and replication strategies of viruses and sub-viral agents; Regulation of viral genome expression.
- **Tumor Virology:** Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and altered cell cycle, metastasis, virus - induced cancers, molecular mechanisms of tissue transformation and tumorigenesis by viruses; Therapeutic interventions of uncontrolled cell growth; Oncolytic viruses and mechanism.

Unit 7: Animal and Human Virology and Virus Diseases

- **Animal and Human Virology:** Influence of virus on host organism - Cytopathic effects, inclusion bodies, chromosomal aberrations; Host defense against viral infections - innate and adaptive immune response to viruses; Vertical and horizontal transmission of animal and human viruses; Viral nosocomial infections and zoonosis; Mechanism of infection and virus spread in the human body; Epidemiological concepts of virus diseases, disease determinants; virus disease surveillance; surveys; Quarantine; Prevention (sanitation, vector control, vaccines and immunization) and control (chemoprophylaxis, chemotherapy (antiviral drugs, Interferon therapy) of viruses
- **Animal and Human Virus Diseases:** (Emphasis should be given to etiology, transmission, clinical manifestations, diagnosis, prevention and control) Animal virus diseases - Foot and Mouth Disease; Infectious bursal disease; Newcastle disease; Blue tongue disease, Sheep pox virus disease; Rabies disease; Human virus diseases – Polio disease; Rotavirus disease; coronavirus disease (SARS - CoV - 2); Chikungunya; Hepatitis C; Dengue fever; Influenza; Ebola; Human Immunodeficiency disease; Smallpox; Herpes simplex; Human papilloma disease; Human adenovirus disease; Hepatitis B; Zika; Nipah; Swine flu; Prion diseases (Scrapie, Kuru, CJD); Biology and control of major viruses of silkworm, fish and prawn.

Unit 8: Applied Virology and Virus - based nanotechnology

- **Applied Virology:** Viruses as unique resources and as model systems in molecular biology and their applications - Virus - based vectors, gene therapy, viral genes as source of novel enzymes, gene expression activators and silencers; Display of foreign peptides on viruses; Viral biopesticides; Viruses as biological warfare, bio-crime and bioterrorism agents; Recombinant antibodies and their applications; Biosafety and biosecurity - Biosafety levels and risk groups, good laboratory practices (GLP), good manufacturing practices (GMP) decontamination and sterilization procedures, safety rules; Ethics in virus-related research, ethical and regulatory issues in animal experiments, basics in intellectual property rights and Indian patenting system.
- **Virus - based nanotechnology:** Viral nanoparticles (VNPs), virus-like particles (VLPs), plant virus-derived nanoparticles (PVNs), Functionalization (chemical conjugation, genetic engineering, infusion) of PVNs; Biodistribution and pharmacokinetics; Application of plant viruses as biotechnological tools in medicine, industry and agriculture.