Life Sciences

UNITI:-Immunology

Introduction Phylogenyof ImmuneSystem;InnateandAcquiredSystem;Clonalnature of ImmuneResponse. Organisationandstructure of lymphoid organs. Cells of the Immune system: Hematopoiesis and differentiation, Lymphocyte traffic, T- lymphocytes and B- lymphocytes, Macrophages, Dendritic cells, Natural killer and Lymphokine activatedkillercells,Eosinophils, Neutrophils, Basophils andMastCells.B-cellsandT- cell receptors, generationof diversity.

Nature and biology of antigens.Antibody generation, structure and function.Antigen-antibodyinteractions.Monoclonal antibodiesand Hybridomatechnology, ELISA and RIA,FlourescenceandSpectralmethodsused inImmunology.Majorhistocompatibility complex.

The ComplementSystem. Cytokines andtheir role in immune regulation. MHC restriction.Macrophagemediated cytotoxicity.

Immunological tolerance and immunosuppression.Hypersensitivity. Autoimmunity

UNITII:-Biochemistry

Vitamins: their coenzyme forms, biochemicalfunction, important sources and deficiency symptoms.

Principles of bioenergetics, Glycolysis: its stages, enzymatic steps, energetics, regulation. HMP pathway, Glycogenolysis, Tricarboxylicacid cycle. gluconeogenesisfrom aminoacidsandTCAcycle intermediates,synthesisofglycogenandimportantdisaccharides,Hormonalregulationof carbohydrate metabolism.

Mobilizationof lipids, Oxidationof lipids:betaoxidation.Oxidationofunsaturatedand odd chain fatty acids, energetics, Formation and oxidation of ketone bodies. Biosynthesis ofsaturatedfattyacids:carbonsources,acetylCoAcarboylasceandreactionsofFatty acidsynthase,synthesisofoddchainandunsaturated fattyacids.Triacyleglyceroland

phosphoglycerides.Biosynthesis of cholesterol and its regulation.

Amino acid metabolism Deamination and transamination ,urea-cycle: reactions and regulation. Genetic defects in amino acid metabolism.

Biosynthesis and Degradation of purine & pyrimidine nucleotides and its regulation.

Geneticdefectsinnucleotidemetabolism.
Physicochemicalpropertiesofwater:pHscale,Henderson-Hasselbach equation and its applications, preparation of buffers (problems), pH measurements.

Protein:Peptidebond,N-andC-terminalresidues,peptidegroup.Peptideunits: Bond lengths and angles, cis- and trans-conformations, reaction of peptide bond, charges on peptides(pH-dependence). Levels ofstructure in Proteins: primary structure, secondary structure,tertiarystructureandquaternarystructure.Aminoacidcomposition andsequencedetermination.:Ramachandranplot,Secondarystructure:(α and other helices, ß-structures, ß-turns), collagen triple helix .protein analysis methods

Techniques: Basic principles and applications of Electrophoresis.chromatography.spectroscopy and radiochemical and immunochemical techniques.

Enzymes:classification and nomenclature.Effect of pH and temperature on enzyme activity. Basic Equations of Enzyme Kinetics:SteadystatekineticsoftheMichaelis-Menten equation.Michaelis–Mentenmechanism:interpretationof thekinetic phenomenaforsingle-substractereactions ThesignificanceoftheMichaelis–Menten parameters.TheLineweaver–BurkplotandtheEadie–Hofsteaplot.Theenzymeinhibition:
Competitive, noncompetitive, uncompetitive and mixed inhibitions.Commiting substrates for an enzyme.Conformational change and allosteric regulation; positive cooperativity;mechanism ofallostericinteractionsandcooperativity;Negative cooperativity.ribozymesand abzymes.

UNIT III:- MolecularBiology

PrimaryandSecondarystructureofNucleicAcids,Pioneeringexperimentsleadingtothe

developmentofmoderngenetics,Structure ofDNAandtheGene,Finestructureofthe gene. Gene-protein relationship, DNA Replication models of DNA replication, semiconservative replication, organization of the replicating chromosome, mechanism of replication, Enzymes involvedinreplication.

Recombinationinbacteriaand their viruses, sexfactors,highfrequencyrecombination strains, Gene conversion and Genetic mapping, General homologous recombination. Site specificrecombination.

The molecular basis of gene mutation, Consequences of mutations for protein structure, Induction of mutations in prokaryotes. Chemicalmutagenesis in higher organisms, Repair of DNA damage: Photoreactivation, excision, post replication and SOS repair mechanisms,Factorsdeterminingsensitivity toDNA–damagingagents,RepairofDNA damages in higher organisms.

TranscriptionofDNA:RNApolymerase,sigmafactor, Initiation,chainelongation, termination, posts transcriptionalmodifications,andmRNAandantibioticsaffecting transcription.TheGeneticCode:evolutionof thecode,degeneratetripletcode,Protein synthesis: t-RNA as adapter molecule, ribosomestructure,ribosomalgenes.Initiation, elongation and termination of protein synthesis, Modifications of protein synthesis, Inhibitors ofprotein synthesis.

Enzymeinductionandrepression,Thelacoperon:negativecontrol,catabolicrepression ofthelacoperon:positivecontrol,Positive controlwithsuperimposednegativecontrol, The arabinose operon, Negativecontrolwithsuperimposedattenuation:thetryptophan genes. The lambda phage: a complex of operons. Antisense RNA.

Early discoveries, the beginning of recombinantDNAtechnology,Restrictionmapping vectors, cloning, selection of recombinant clones, DNA Sequencing, gene probes, other applications of recombinant DNA technology.

Structure of chromatin, packaging of DNA,coding and non coding sequences, satellite DNATransportationineukaryotesRNAprocessing(capping,polyadenylation, introns and exons), Ribonucleoproteins, structure of mRNA translational modification.

The law of DNA constancy and C value paradox; Numerical and structural changes in chromosomes; Molecular basis of spontaneousand induced mutations and their role in evolution;

Environmental mutagenesis andtoxicity testing; Population genitics. Polyploidy : Genetic variability. Introduction of Evolution, Prebiotic Synthesis, RNA Catalysis:A basis for a precellular genetic system, A reconstruction analysis of cell lineages.

UNIT IV:-Recombinant DNATechnology

Toolsof geneticengineering,Restrictionendonucleases,DNApolymerases,ligases,kinases phosphatases,reversetranscriptase,exonucleases,ribonucleases,proteinases.

Cloning Vectors. Plasmids &cosmids. Phages, BAC, YAC, transponsons. Labellingofnucleic acids.Radioactive andnonradioactivelabellingtechniques. Nick translation, end labelling,pimerextension,randompriming.

Genecloning.Genomicand cDNAlibraries.Chromosomewalking,genetagging,subtraction hybridization, difference hybridization.Hybrid arrested translation, hybrid released translation.*Invivo*expressiontechniques,southernblotting,northernblotting.

Latest techniques in rDNAtechnology.DNA Fingerprinting RFLP, RAPD, DNA Footprinting.PCR,immuno-PCR,Sequencingof DNA.Site-directedmutagenesis,pulsefield gelelectrophoresis.CellTransformations:Methodsof plantcelltransformations.Vectorsfor plantcelltransformation.Proteinandnucleicacidgelelectrophoresis.

UNITV:-Cell Biology

Early membrane models, Principles of membrane organisation, Detailed structure of erythrocyte membrane, Transport across membrane- Diffusion of small molecules across phospholipidbilayer,overviewofmembranetransport proteins, Intracellular Ion environmentandmembraneelectricpotentials.GLUT1transportglucose intomammalian cells,Ca++-ATPase,Na+/K+ATPase,Na+ linkedsymporters,Importaminoacidsand glucose , Na+-linked AntiporterCa++ fromcardiac muscle cells.

Compartmentalisatonof eukaryotic cells, Structure and functional features of Endoplasmic reticulum, Golgi complex, Lysosome, Mitochondria .Structure of Chloroplast.Ribosomes.

Nuclearenvelope:morphology,ultrastructureandbiochemicalroleofnuclearenvelope in nucleocytoplasmicinteracton.

CellCycle, Chromosome,morphology,composition,Organization ofDNAinto chromosome.

Majorclassesofeukaryotesgenes, Duplicated protein codinggenes,Tandemlyrepeated genes encoding r-RNA and Histone, Repetitious DNA function, simple sequence DNA, Intermediate repeat DNA and mobile DNA elements, Functional rearrangement in chromosomal DNA.

Characteristicoftumourcells,Useofcell cultureincancerresearch,DNAvirusesand transforming agents.Human tumour viruses, Chemical carcinogencesis. The role of radiation and DNA repair in carcinogenesis,Oncogenes and their proteins: Classification and characterisation, The role of cellular oncogenes in carcinogenesis, The multistep nature of carcinogenesis, Ageing, Apoptosis.

UNITVI:-Microbiology

HistoryandScopeofMicrobiology.MicrobialBiodiversity:ProkaryotesandEukaryotes,
Bacteria, Rickettsias, Chlamydias, Mycoplasmas, Cyanobacteria, Protozoa, Fungi, Algae and Viruses.Major Charactersticsused in classification of Microorganisms. Classification systems: Numerical Taxonomy, Phylognetic system, Phenetic Systems,

Bacterial size, shapes and pattern of arrangement. Structures externalto cell wall: Flagella,Pili,Capsule,Sheath,Prosthecaeand Stalk.Structureandchemicalcomposition of cellwall.Structuresinternaltocellwall:Cytoplasmicmembrane,Protoplast, Spheroplast,Cytoplasmicinclusions,Nuclearmaterial,SporesandCysts.Nutritional typesofbacteria.Bacteriologicalmedia.Physicalconditionsinfluencing growth: Solutes and water activity, pH, temperature, Oxygen concentration, Pressure, Radiation etc. Modesofcelldivision,Growthcurve,Synchronousgrowth,Batch culture, Continuous culture, Quantitativemeasurement of growth. Bacterial Metabolism: Breakdown of glucosetopyruvate,TCAcycle,Electrontransport and oxidativephosphorylation, Fermentation and anaerobic respiration.

Definitions and fundamentalsof control.Conditions influencingantimicrobialaction. Physicalagent/processesusedforcontrol: Heat, Filtration,Radiations.Chemicalagents: Phenolics, Alcohols, Halogens, Heavymetals,Quarternanyammonium compounds, Aldehydes,Sterilizinggases.

Evaluation of antimicrobialagenteffectiveness. Chemotherapeutic agents and antibiotics:Historyofchemotherapy,General characteristics, sulfonamides, Penicillin, Cephalosporin, Aminoglycosides, Chloramphenicoalandotherantibiotics, Antifungaldrugs.DrugResistance:Mechanism of drug resistance, Origin and transmission.

Germfree(Gnotobiotic)animals.Normal microfloraofhumanbody:Skin,Eye, Respiratory tract, Intestinal tract, Genitourinary tract. Host parasite interaction. Determinantsofinfectiousdiseases:Transmission,Attachment, Colonization, Entry, Growth andmultiplication. Toxigenicity. Exotoxin, Endotoxins, Leukocidin, Haemolysins.NonspecificDefenseMechanismsofHost:Generalbarriers, Physical barriers, Chemical barriers,Biological barriers, Phagocytosis, Inflammation, Fever.

Microorganismsfoundinfoodandtheirsources.Extrinsicandintrinsicparametersof foodaffectingmicrobialgrowth.Microbial spoilage of Vegetable, Fruit, Dairy products, Beer and wine. Food preservation: Physicalremoval of microorganisms, Temperature effects, Chemical agents and Radiation. Food borne diseases. Microbiologyoffermented food: Dairy products, wine, Beer and other fermented alcoholic beverages. Microorganisms as a source of food.

HistoryofVirology,Distinctivepropertiesof Viruses,ViroidsandPrions.Cultivationof Viruses.Virus Purification and assays.General morphology.Viral nucleic acid and its replication.Capsid and envelope.Bacteriophages.Morphology and structure. Replication:Adsorption,Penetration,Synthesisofnucleicacidandprotein,Assembly andrelease.TemperatephagesandLysogeny. Controlofviruses:Interferon,Chemical antimicrobial agents andAntiviral antibiotics.

UNIT VII:-PlantPhysiology

Membrane transportand translocation of water and solutes: Plant-water relations, mechanism ofwatertransportthroughxylem,root-microbeinteractionsinfacilitating nutrientuptake,comparisonofxylem andphloem transport,phloem loadingand unloading, passive and active solute transport, membranetransportproteins.Stomatal physiology; Source &sink relationship.

Signaltransductioninplantsoverview,receptorsandG-proteins,phospholipidsignalling, roleofcyclicnucleotides,calcium-calmodulin cascade,diversityinproteinkinasesand phosphatases, specific signallingmechanisms.

Photochemistry and photosynthesis: Historical background, photosynthetic pigments and lightharvestingcomplexes,carbon assimilation – the Calvincycle, photorespiration and its significance, C4 cycle, the CAM pathway, biosynthesis of starch and sucrose.

PhotosystemsI&II,theirlocation,mechanism ofquantum captureandenergytransfer between photosystems – ferridoxin, plastocyanin,plastoquinone,carotenoids.

Respiration:Aoverviewofplantrespiration.Respiratoryquotient,factorsinfluencing the rate of respiration (light, temperature, oxygenavailabilityetc.)

Nitrogen&Sulphurmetabolism:Biological nitrogenfixationandammoniaassimilation. Nitrate and sulphate reductionandtheirincorporationinto amino acids (uptake).

Physiology of seed dormancy and germination.Hormonal regulation of growth and development.Photoregulation: Growth responses, physiology of flowering. Vernalization, Senescence.

Stressofphysiology–Plantresponsestobioticandabioticstress,stress tolerance.Types of stresses (drought, salt, high temperature, chilling and flooding). Effects of stress: stress resistance, avoidance and tolerance (salt excluders and includers), various morphological andphysiologicaladaptations.Accumulation of various solutes (osmoregulants/ osmoprotectants):withspecialemphasison roleofproline,sugarsk+ionsand polyamines, Role of growth regulators in stress.

Briefhistoricalbackground,generaltechniques,Tissue culturemedia,Cellular totipotency, Micropropagation and somaclonal variation, production of pathogen free plants.Role of tissue culture in Haploid and triploid production. Production of secondary metabolitesandproductionofplantstolerantto differentstresses,Otherapplicationsof planttissueculture.

Principle of cell Based Cloning, Restriction endonuclease, Ligases, Transfer of DNA into the host cells; Modes & Methods (Transduction, Conjugation and Transformation), Yeast Artificial Chromosome (YAC), cosmid vectors. ChromosomeWalking.

UNIT VIII:- AnimalPhysiology

An over view of Physiology (general and cellular basis), concept of primary and secondarymessenger, Endocrine cells and types of chemical signalling Molecular mechanism ofactionofdifferenttypesofhormones:Regulatoryroleofhormonesfrom hypothalamus,pituitory,thyroid,Adrenal, Pancrease and other endocrine cells. Malfunctionand clinicalcorelates.

Neurons & supporting cells, ionic basis of resting and action potenial, synaptic transmission,excitatory/inhibitory,preandpostsynapticinhibitions, reflexesandtypes, Autonomic nervous system, functional differentiation of brain and hierarchy of control, Motor functions of spinal cord, Motor and sunsory pathways, intellectual functions of brain, learning and memory, limbic system, Brain activity-sleep.

Sensory Receptors, types, transduction mechanism, Neuronal architecture of retina and optic pathway, visual transduction, skeletal cardiacandsmoothmuscles.Neuromuscular junctions,Mechanism ofmuscle contraction.(Crossbridgemodel)Muscletone regulation.

Exchangeofgasesatpulmonarysurface, transportofrespiratorypigment.Oxygen dissociation curve, Neural and hormonal control of breathing.Oxygen, carbon diosixide and pH sensing mechanism, Respiratory acidosis and alkalosis.Regulation of blood pH.

Initiation, conduction and regulation of hearth beat, cardiac cycle, ECG and cardiac out put, Bloodpressure and its regulations. Blood coagulation. Regulation of cardiac functions.,Glomeularfiltration,reabsorption secretion and its regulation, Rennin / Angiotensinsystem.

Basicstructureandfunctionofovaryandtesties,hormonalregulations, parturition and implantation.Molecular events during fertilization, concept of determination, competence and induction to potency, cell differentiation and differential gene activity, genetic regulation of early embryonic development, Homoetic gene

UNIT IX:- EnvironmentalBiology

Definition,history,subdivisionsofecology.Definition&componentsofenvironment.
External and internal environment. Naturalandmanmadeenvironment. Population, community (type of

communities),ecosystems (components of ecosystems, types of ecosystem), biosphere.

Light-(Albedo,Sciophytes,Heliophytes,Compensationpoint), temperaturealtitutidinal and latitudinal variation, Temperature stress, Stenothermal, Eurythermal organisms, Permafrost,Homeotherms,Poikilotherms.

Precipitation-Humidity,Monsoon,Gases–CO_2, O_2cycles.Wind-Globalaircirculation, Inversion, Windbreak, Fire.

Topographic-Height direction of mountain and valley, steepness and exposure of slopes. Edaphic-Soilformation(Weatheringofrocks,Mineralisationandhumification),Soil nutrient,Soilcationexchangecapacity,nutrientavailability,Soilmoisture,Soiltexture, Soil type, Soil aeration, Soil mixing.Biotic- Positive and negativeinteractions.

Typesof ecosystems(Aquatic&terresterial, naturalandmanmade,Ocean,estuaries, lakes,rivers,grasslands,foresttypes,fishand fisheriesofIndiawith respecttothe managementofestuarine,coastalwatersystem andmanmadeecosystem)Structureof ecosystem (Specialdiversity,Speciesstructure,Trophiclevels),Functionofecosystem (Energy flow, Material cycling – hyderological, gaseous and sedimentrary), Ecological pyramids,Primaryandsecondaryproductivity, Foodchains(Grazinganddetritus),Food web.

Morphological,Anatomical&PhysiologicaladaptationsofHydrophytes,Mesophytes and Xerophytes.

Communityoriginanddevelopment.Typesof Succession–Pressere(primary),Subsere (Secondary),AllogenicanddeflectedCausesofSuccession –Climatic,Topographic& Biotic, process and succession, Nudation Invasion, Migration, Ecessis, Aggregation, Competition, Reaction and Stabilization, Climax.

Extinct and Threatened Species, Wild Life Conservation (Santuries, National parks).