SVURPGCET-2010: SYLLABUS
Test - 25: MICROBIOLOGY

SECTION A

General Microbiology: Scope and importance of Microbiology-human, animal, plant and industrial importance. Development of Microbiology in twentieth century. Major mile stones in the historical development of Microbiology. Important contributions of Scientists and their role in Microbiology-Taxonomic status of the microorganisms-concepts of Whittaker and Carl Woese, general characteristics and classification of fungi, bacteria, viruses, microalgae and protozoa. Principles of microscopy- and types of micro scopy and microscopic observation- observation of microorganisms. Structure of microorganisms- of prokaryot and eukaryot. Chemical constituents of cells-Proteins, carbohydrates, lipids, glycoproteins, glycolipids, nucleic acids, nucleoproteins, pigments.

Sterilization-Principles and methods of sterilization and disinfection (dry, wet, heat, radiation, filtration and chemical). Isolation of microbes-Principles of isolation, cultivation, enumeration and maintenance of various microbial cultures. Isolation from different natural sources, methods for obtaining pure cultures, cultivation of aerobes and anaerobes. General properties- of-Prokaryotic and eukaryotic microorganisms viruses, bacteria, mycoplasma, rickettsia, algae, fungi and parasitic protozoa. Microbial production and replication-Principles of reproduction of bacteria, fungi, algae and protozoa Discovery and nature of viruses. Nomenclature and classification of viruses as per ICTV. Biological, physical and biochemical (proteins and nucleic acids) properties of viruses. Composition, morphology, and replication of viruses-TMV, HIV, T4 and lambda phages. Cultivation and assay of phages, plant and animal viruses.

Microbial Physiology and Metabolism: The concepts of microbial metabolism and their significance. Elemental nutrient requirements of microbes-nutritional groups of bacteria; autotrophy-photoautotrophy and bacterial photosynthesis; chemoautotrophy and autotrophic metabolism; heterotrophy-photoheterotrophy and chemoheterotrophy, heterotrophic metabolism in bacteria; nutritional mutants and their use in metabolic studies. Transport of nutrients in microbes-types and mechanisms of transport methods for studying of transport, coupling of transport of ions and metabolites to ATP/Proton gradient.

Bacterial Growth: Building of macromolecules from elemental nutrients, supramolecules, cell components and cells; cell cycle in microbes and generation times; batch culture phases and importance of each phase, continuous cultures, synchronous culture, factors influencing the microbial growth.

Bioenergetics : Concepts of free energy and thermodynamic principles in biology, energy transformation, ATP cycle, standard free energy of hydrolysis of phosphate compounds, energy transducers, redox potentials, free energy changes in redox reactions.

Bacterial Photosynthesis : Oxygenic and anoxygenic types of photosynthesis, basics of photochemistry, halobacterial photosynthesis, sulphur. Chloroplast mediated and chemolithotrophic electron transport systems.

Microbial Respiration: Different metabolic pathways-Glycolysis, EMP, ED, HMP and phosphoketolase in microorganisms, gluconeogenesis; synthesis of peptidoglycans and glycoproteins. Aerobic and Anaerobic respiration of microbial organisms.

Microbial toxins and extra cellular enzymes : Exo-and endotoxins: physiology of toxin production; mode of action of toxins and extra cellular enzymes and their importance in pathogen virulence and pathogenesis.

Molecular Biology: Structural organization of prokaryotic cells, eukaryotic cells, ultra structure of animal and plant cells. Structure and functions of cell organelles and their chemical composition. Types of cell division and its importance in prokaryotic and eukaryotic organisms. Mendelian genetics, identification of DNA and RNA as genetic material. Chromosomes-Chemical composition, structural rganization and banding patterns of chromosomes.

Sex determination implants and animals, sex-linkage, chromosomal theory of inheritance, linkage and crossing over, mapping of genes, chromosomal aberrations and hereditary effects. Microbial genetics - isolation of auxotrophs, replica plating, analysis of mutations in biochemical pathways, one gene-one enzyme hypothesis, plasmids, insertion sequences, transposons. DNA replication - Models, mechanism and enzymology of DNA replication in pro-and eukaryotes, DNA damage and repair. Transcription - organization of protein and RNA coding genes, types of RNA transcripts and their role. Promoters and RNA polymerases, mRNA transcription and processing. Translation - Genetic code, ribosomes and tRNAs, and events of protein biosynthesis in pro - and eukaryotes. Regulation of gene expression - concept of operon, repression and induction of genes regulation of genes in lac operon. Outlines and scope of genetic engineering, molecular vectors-cloning, shuttle and expression vectors. Restruction endonucleases and their biological significance, applications in genetic engineering.

Cloning strategies - construction of recombinant vectors and molecules and DNA genomic DNA libraries. Expression of cloned genes in pro-and eukaryotic cells. Different types molecular techniques and their application - Radioactive and non-radioactive nucleic acid probes and nucleic acid hybridization, southern and northern blotting, nucleic acid sequencing, PCR, RFLP, DNA fingerprinting and site directed mutagenesis.

SECTION B

Immunology: History, scope and important milestones of immunology. Types of immunity - and cell mediated, active. Immune cells, primary and secondary lymphoid organs of the immune system. Types of antigens - bacterial, viral, fungal, parasites, haptens, mitogens and immunogens. Antibodies - Polyclonal and Monoclonal antibodies - structure, Types and production of antibodies and their applications. Types of complements and Complement cascade system, complement fixation test. Antigen antibody reactions - in vitro and in vivo serological reactions. Properties and functions of lymphokines, cytokines, chemokines, interferons and intrleukins. Types of hypersensitivity and allergic reactions, autoimmune and immunodeficiency diseases. Transfusion immunology - blood cell components, ABO blood grouping, Rh typing. Transplantation immunology-graft versus host reactions, tissue and organ transplantation. Tumor immunology -

types of tumor and their immunological response. Production and types of vaccines and immunization - passive and active immunization, killed inactivated, live attenuated and recombinant vaccines.

Medical Microbiology: Basics of Medical Microbiology : History and scope of medical microbiology, Classification of medically important microorganisms. Normal microbial flora of human body.

Infection : Definition of infection, sources of infection for man; vehicles or reservoirs of infection. Exogenous and endogenous infections, mode of spread of infection.

Microbial Pathogenicity: Transmissibility, infectivity and virulence, opportunistic pathogens, true pathogens, toxigenicity; invasiveness and other aggressins, organotropism, variation and virulence. Antimicrobial therapy: Methods of drug susceptibility test, antibiotic assay in body fluids, mechanisms of drug resistance. General account of Medically important diseases: Causal organisms, pathogenesis, epidemiology, diagnosis, prevention and control - Air borne diseases (Tuberculosis, Influenza), Food and waterborne diseases (Cholera, Typhoid, Hepatitis-A), Insect borne diseases (Malaria, Japanese B encepahalitis, Dengue fever, Chikungunya), Contact diseases (Syphilis, herpes), Zoonotic diseases (Rabies, Anthrax), Blood borne diseases (Serum hepatitis, AIDS), Prion diseases (Kuru, Madcow, CJD). Laboratory cultivation, Isolation and diagnosis of Microorganisms: Principles of bacterial, viral and fungal cultivation by conventional and advanced methods. Serological diagnosis, Immunochemical methods and Molecular methods for identification of infectious diseases. Laboratory methods for diagnosis of Microbial diseases: General characteristics, epidemiology, pathogenesis, spectrum of diseases, laboratory diagnosis. Prevention and control of microbial diseases-chemotherapy, interferons and base analogues, immunization, vaccines (killed, live attenuated, recombinant).

Applied Microbiology: Microorganisms related to plant growth promoting - mycorrhizae, rhizobia, Azospirillum, Azotobacter, Cyanobacteria Frankia and phosphate solubilizing microorganisms), Nitrogen fixing microorganisms - symbiotic, non-symbiotic. Role of microorganisms in environment - soil, water and air; nutrient cycling - carbon, nitrogen and phosphorus; microbial interaction - mutualism, commensalisms, antagonism, competition, parasitism and predation.

Food Microbiology-Microorganisms foods spoilage, food intoxication, food borne diseases.

Scope of microbial technology - Design and operation of conventional fermenters, down stream processing, cell and enzyme mmobilization technology, bioreactors, applications of the technology to industry. Fermentation technology-production of alcohols, amino acids, organic acids and solvents, vitamins, sugars, antibiotics and biocatalysts. Food fermentation technology-production of bread, wines, beverages and cheese. Production of single cell proteins (SCPs), biofertilizers-cultivation and mass production of BGA and bacterial based inoculants (BBI). Production application of biopesticides - viral, fungal based pesticides. Scope, utilization and production of biofuels. Environmental biotechnology-role of microorganisms in petroleum and mining industry, cleaning up of heavy metals, microbes and enzymes in waste water treatment.Recombinant DNA technology-large scale production of human and animal recombinant vaccines.

SECTION C

Chemistry related to Biological Sciences :

Introduction to chemistry of life-Macro and microelements of biological importance. Chemical bonding-Principles of chemical bonding, covalent, non-covalent, electrovalent, ionic bonds, bond lengths and angles and bond dissociation energies. Organic reagents and reactivity - electrophilic, mesophilic and free radical reagents. Buffer solutions - Handerson equations, applications of buffers, hydrolysis of salts, pH calculation of salt solutions and pH variation in acid-base titrations, acid-base indicators. Biological macromolecules-Classification, structure, properties of carbohydrates, lipids, proteins, enzymes, nucleic acids, porphyrins and other macro molecules. Bioenergetics-Concepts of free energy, energy transformation, redox potentials. elementory account of bioenergetics, respiration, glycolysis, krebs cycle, fermentation, electron transport and oxidative phosphorylation.

Photosynthesis - mechanism, photosynthetic electron transport. C3, C4 and CAM pathways for CO2 fixation. Factors affecting photosynthesis. Nitrogen metabolism - Nitrogen fixation and nitrogen cycle. Out lines of biosynthesis of amino acids and proteins. Nucleic acids types, structures and properties. Nitrogen excretion in animals. Enzymes-General account of enzymes-Introduction to biocatalysis, chemical and biological catalysis, apoenzymes and coenzymes, activation energy, transition state, allosteric enzymes. Growth hormones and vitamins in plants and animals.

Biophysical and Biochemical techniques :

Principles and applications of microscopy - light and electron microscopy.

Chromatography - paper, thin layer, column, ion-exchange, affinity and HPLC.

Types, principles and applications of filtration. Principle and applications of Colorimetry.

Centrifugation-types and applications of differential, equilibrium and density gradient centrifugation methods.

Electrophoresis-principle and applications of paper, agarose and polyacrylamide gel electrophoresis.

Nuclear chemistry-Composition of nucleus, radioactive disintegrations, use of radisotopes in Agriculture, Industry, Medicine and chemical analysis. Tracer techniques-counting of radioactivity by liquid scintillation counter.

Environmental chemistry - Inorganic metals in Biological systems, Air, water, soil and Radio active, pollution, harmful effects of organic and inorganic pollutions.

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