

# **SYLLABUS FOR POST GRADUATE ENTRANCE EXAMINATION IN MICROBIOLOGY-2019-2020**

## **Unit-1**

Development of microbiology as a discipline, Spontaneous generation vs. biogenesis. Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming Role of microorganisms in fermentation, Germ theory of disease, Contributions of Martinus W. Beijerinck, Sergei N. Winogradsky, Selman A. Waksman, Edward Jenner.

Systems of classification Binomial Nomenclature, Whittaker's five kingdom and Haeckel's three kingdom classification systems and their utility. Difference between prokaryotic and eukaryotic microorganisms . General characteristics of different groups: viruses, fungi, algae, protozoans, cyanobacteria, actinomycetes.

## **Unit 2**

Definitions of growth, measurement of microbial growth, Batch culture, Continuous culture, generation time and specific growth rate, synchronous growth, growth curve, Nutritional classification Autotroph/Phototroph, heterotrophy, Chemolithoautotroph,

Carbohydrate metabolism- , Glycolysis , TCA cycle. & their significances

Metabolism of proteins and amino acids -. Transamination, deamination, decarboxylation; Urea cycle

Lipid Metabolism: Fatty acid oxidation ( $\beta$  oxidation), Ketone bodies.-types, significances of ketone bodies.

First and second laws of Thermodynamics. Definitions of Gibb's Free Energy, enthalpy, and Entropy. Standard free energy change and equilibrium constant, Energy rich compounds.

Definition- General characters of carbohydrates, classifications, Biological Importance of Carbohydrates, Functions of carbohydrates, Isomerism

Lipids: Definition, Classifications, Physical & chemical properties, Biological Importance of lipids and fats. Proteins and amino acids: Definition, Classifications, Physical and Chemical Properties of Proteins and Amino acids, Structure of Proteins, Biological importance of Proteins and Amino acids.

Enzymes : Definition, Classification of enzymes, Mechanism of action of enzymes: active site, Lock and key hypothesis, and Induced Fit hypothesis. Significance . Factors affecting enzyme activity, Applications of enzymes.

Classification and characteristics with suitable examples of Vitamins , sources and importance

### Unit-3

Microscopy: working principle, construction and operation of different types of Microscope-simple, compound, phase contrast, fluorescent and electron microscopes, Micrometry and Photomicrography.

Microbiological media- types chemical composition, preparation, -simple media, complex media, special, differential, indicator, enriched, enrichment & transport media. Preservation of media.

Pure culture techniques-different methods of isolation of pure cultures, pour plate method, streak plate method, spread plate method, serial dilution method. Maintenance & Preservation of Microbial Cultures – slant culture, stab culture, soil method, mineral oil overlaying, glycerol preservation, liquid nitrogen, Lyophilization method. Types of culture collection centres- Indian & global ATCC, NCIM, MTCC etc.

Staining Techniques:- Nature, types of stains, principle, mechanism of Simple, differential-Gram's staining, AFB Staining, Negative staining, Structural staining- spores staining, flagella staining, capsule staining, food granules staining, Algae & Fungal staining methods & wet mounting methods.

Working principle and operation of instruments used in microbiology laboratory- Autoclave, laminar air flow, incubator, pH meter, Spectrophotometer, centrifuge, BOD incubator.

Working principle and operation of laboratory equipments- Chromatography, X-ray diffraction crystallography, NMR, Mass Spectroscopy, HPLC.,

### Unit-4

General account of the microbes used as biofertilizers for various crop plants and their advantages over chemical fertilizers. Symbiotic N<sub>2</sub> fixers: *Rhizobium* - Isolation, characteristics, types, inoculum production and field application, Cyanobacteria, *Azolla* –

Free living *Azospirillum*, *Azotobacter* - free isolation, characteristics, mass inoculums, production and field application. Phosphate solubilizing microbes - Isolation, characterization, mass inoculum production, field application  
Importance of mycorrhizal inoculum, types of mycorrhizae and associated plants, Mass inoculum

production of VAM, field applications of Ectomycorrhizae and VAM.

General account of microbes used as bioinsecticides and their advantages over synthetic pesticides, *Bacillus thuringiensis*, production, Field applications, Viruses – cultivation and field applications.

Soil\_ types ,components and types of distribution of microbes in soil significance of soil microbes, soil fertility & Crop productivity.

#### **Unit-5**

Soil\_ types ,components and types of distribution of microbes in soil significance of soil microbes, soil fertility & Crop productivity, Microbial Ecology-Ecological niche, Ecological Succession. Biogeochemical cycles & Microbes role – Carbon, Nitrogen, Phosphorus.

Microbes in Extreme environments- Extremophiles,

-Psychrophilic, thermophilic, acidophilic, halophilic. Water pollution- sources, characters of water pollution, health hazardous due to water pollution, control measures for water pollution & water quality testing (MPN Technique).

-Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, Predation ,Microbe-Plant interaction: Symbiotic and non symbiotic interactions

Waste water Treatment methods- Primary-Physical methods, Secondary-Biological methods- Trickling filters, Activated sludge process, Oxidation ponds, Imhoff tank Anaerobic digesters, septic tank. Tertiary methods- Filtration, chlorination, Radiation & Reverse Osmosis.

Air pollution- sources, characters and air pollutants, health hazards due to air pollutants. Soil Pollution- Sources, and characters of air pollutants, effects of soil pollutants on human health & Crop productivity. Solid waste management- handling and treatment methods of solid waste.

Microbial Degradation of Pesticides (xenobiotics), Polycyclic aromatic hydrocarbons, cellulose, lignin and plastic. Biological Nitrogen fixation- symbiotic, Non-symbiotic, Rhizosphere, Phyllosphere, Mycorrhizae.

Microbial remediation: concept & Scope of Bioremediation, methods & types of bioremediation. Microbial Leaching- origin & concept, Mechanism & role microbes in recovery of important minerals- Iron, copper, gold.

#### **Unit-6**

Fermented Foods :Definition, types, advantages and health benefits, types of fermentors and fermentation process. Milk Based Fermented Foods: Dahi, Yogurt, Buttermilk (Chach) and cheese: Preparation of inoculums, types of microorganisms and production process Grain Based Fermented Foods Soy sauce, Bread, Idli and Dosa: Microorganisms and production process

Fermented Foods :Pickles, Saurkraut, cheese, Bread- Microorganisms and production process

Contamination, spoilage and preservation of meat & meat products, fish & fish products, milk & milk products, fruits & vegetables. etc

Probiotic Foods: Definition, types, methods of isolation of probiotic microorganisms and health benefits

Introduction to Industrial microbiology :Brief history and developments in industrial microbiology, Types of fermentation processes - solid state, liquid state, batch, fed-batch and continuous. Types of fermenters – laboratory, pilot-scale and production fermenters, Components of a typical continuously stirred tank bioreactor

Isolation of Industrial Strains and Fermentation Medium Primary and secondary screening, Preservation and maintenance of industrial strains.

### **Unit-7:**

Raw materials- definition , types of Raw materials, chemical composition, uses of raw materials. Microbial fermentation processes: Downstream processing - filtration, centrifugation, cell disruption, solvent extraction. Microbial production of industrial products - citric acid, ethanol and penicillin, Riboflavin, Acetone - butanol. Industrial production and uses of the enzymes - amylases, proteases

Food as a substrate for microbial growth : factors affect microbial growth in food.

Food contamination-sources, Microbial spoilage of food - milk, egg, bread and canned foods

Principles and methods of food preservation: Physical methods - high temperature, low temperature, irradiation, aseptic packaging, drying, removal of microbes,

Chemical methods - salt, sugar, benzoates, citric acid, ethylene oxide, nitrate and nitrite, Food sanitation and control - GMP & HACCP

Dairy products, probiotics and Food-borne Diseases: Fermented dairy products - yogurt, acidophilus milk, kefir, dahi and cheese, Probiotics definition, examples and benefits

Food intoxication by *Clostridium botulinum* and *Staphylococcus aureus* Food infection by *Salmonella* and *E.coli*

### **Unit-8**

Normal microflora of the human body: Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract, respiratory tract.

Nosocomial infections. Transmission of infection. Sample collection, transport and diagnosis Collection, transport and culturing of clinical samples, principles of different diagnostic tests (ELISA, Immunofluorescence, Agglutination based tests, Complement fixation, PCR,).

### Bacterial diseases:

List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms, mode of transmission, lab diagnosis, prophylaxis and control  
Respiratory Diseases: *Streptococcus pyogenes* *Mycobacterium tuberculosis*  
Gastrointestinal Diseases: *Salmonella typhi*, *Vibrio cholerae*,

### Viral diseases:

with Symptoms, mode of transmission, lab diagnosis, prophylaxis and control  
Hepatitis, Rabies, Dengue, AIDS,

Antigen-Antibody reactions- Precipitation, Agglutination, Immunodiffusion, ABO blood grouping, ELISA, Western blotting, Immunofluorescence,

Protozoans with Symptoms, mode of transmission, prophylaxis and control  
Malaria, Kala-azar, amoebiasis, Trypanosomiasis.

### Unit-9:

DNA as a genetic material & Replication, Recombination: experimental evidences, Hershey & Chase, Griffiths experiments, Replication types and enzymes role in replication. Recombination process- Transformation transduction & conjugation methods.

Genetic code, Protein synthesis, Mutations:

Genetic code- general characters, Protein synthesis- transcription & Translation process, Mutation -definition, Types of mutation- physical and chemical methods. Molecular Techniques- PCR, RFLP, DNA Sequencing methods, Blotting types-southern, western & Northern.

Human diseases : Aetiology, pathogenicity, epidemiology, lab diagnosis, treatment & Control measures of TB, Cholera, Syphilis, Clostridium tetani, typhoid fever, AIDS, Hepatitis, Malaria, Amoebiasis, Candidiasis.

## Fungal diseases

Brief description of each of the following types of mycoses and one representative disease to be studied with respect to transmission, symptoms and prevention, Cutaneous mycoses: Tinea pedis (Athlete's foot), Opportunistic mycoses: Candidiasis, Antimicrobial agents: General characteristics and mode of action.

### **Unit-10:**

Immune Cells and Organs :Immunity types, Structure, Functions and Properties of: Immune Cells – Stem cell, T cell, B cell, NK cell, Macrophage, and Immune Organs – Bone Marrow, Thymus.

Antigens & Antibodies:

Characteristics of an antigen (Foreignness, Molecular size and Heterogeneity); Haptens; Epitopes T-dependent and T-independent antigens; Adjuvants. Antibodies- Structure, Types, Functions and Properties of antibodies, uses. Monoclonal antibodies.

Complement System : Components of the Complement system; Activation pathways (Classical & Alternative pathways) Types of Autoimmunity and Hypersensitivity with examples.