DEPARTMENT OF CIVIL ENGINEERING
ALIGARH MUSLIM UNIVERSITY, ALIGARH
SYLLABUS OF ENVIRONMENTAL ENGINEERING FOR PHD ENTRANCE TEST 2018-19

SECTION - A
Multiple Choice Questions

Part I - Multiple Choice Questions on Research Methodology **(40 marks)**

Writing Skill: Tenses, parts of speech, clauses, subject- verb agreement, Idioms and phrases, reading comprehension, word-meaning, synonyms-antonyms, hyponyms,

Logical and Analytical Reasoning.

Programming Skills: Data types, assignments, conditional statement, branching and looping, input and output statements.

Mathematics and Statistics: Algebra, Ordinary Differential Equation (ODE), Numerical Analysis, Real and Complex Analysis, Vector Analysis, Measure of Central Tendency, Probability Distribution Function.

Part II - Multiple Choice Questions from Syllabus of Civil Engineering. **(20 marks)**

SECTION – B
Subjective Questions

(20 Marks)

Environmental Chemistry: Basic Principles, Chemical Kinetics, Reaction Rates, Oxidation-Reduction reactions, Redox Stoichiometry, Applications of redox Chemistry, Chemical Equilibria, Basic concepts from Equilibrium Chemistry, Solubility Product, Common Ion Effect, Solubility Equilibria, Precipitation-Dissolution, Acid-Base Equilibria, Strong and Weak Acids, Carbonate System, pH, Buffers and Buffer Intensity, Complex Formation, Log Concentration Diagrams, Metal Hydroxide Precipitation, Metal Speciation, Water stabilization, Langlier Saturation Index, Cadwell-Lawrence Diagram, Organic Chemistry, Aquatic chemistry, Atmospheric chemistry, Toxic Compounds, Organic Solvents, Pesticides, Dioxins, PCBs and PAHs, Surfactants, Laboratory practice for determination of ions and solids.

Ecology and Environmental Microbiology: Principles of ecology, Ecosystems, Biotic and Abiotic Components, Trophic Levels, Material and Energy Flow in Ecosystems, Nutrient Cycles, Food chain and Bio-magnification, Ecology of Population. Microorganisms in Wastewater Treatment, Microbiological Concepts- cells, classification and characteristics of living organisms, Characterisation Techniques, Microbial Metabolism, Basic metabolic models, Chemistry of carbohydrates, proteins, fats and lipids, Population Dynamics. Microbial Growth Kinetics, Role of Microorganisms in biogeochemical cycles, Microbiological Analysis, Chemical Composition of Biomass, Waterborne Pathogens, Bacteria, Fungi, Yeast, Algae, Protozoa, Enzymes, Microorganisms as Food, Water and Wastewater Treatment Microbiology, Microorganisms and Air Pollution. Microbiology of Anaerobic Digesters, Sludge Microbiology, Stress on the Microbial Community, Biochemical reactions, Microbiology of aerobic and anaerobic processes, Biochemical pathways, Application of microbiology for pollution control and environmental engineering, Laboratory Practice.

Physical & Chemical Processes: Water Quality, Gas Transfer-Gas Liquid Equilibrium, Two Film Theory, Kinetics, Oxygen Transfer, Aeration Systems, Ammonia Stripping, Coagulation-Colloids, Diffuse Layer Theory, Particle Stability, Mechanisms of Destabilization. Flocculation-Velocity Gradient, Kinetics, Baffled and Paddle Wheel Flocculation, Sedimentation-Discrete, Flocculent and Hindered Settling, Ideal Horizontal Flow Reactor, Up flow Reactor, Design Parameters, Tube Settlers, Granular Media Filtration-Rapid and Slow Sand Filter, Particle Removal Mechanisms and Head Loss, Filter Run and Breakthrough, Constant and Declining Rate Filtration, Filter Backwashing, Dissolved Air Flotation-Design Considerations, Water Fluoridation, Iron and Manganese Removal, Chemical Precipitation-Lime-Soda Softening, Split Treatment, Ion Exchange-Materials and Reactions, Ion Selectivity, Ion

Exchange Equilibrium, Regeneration, Disinfection-Kinetics of Disinfection, Disinfectant Types, Available Chlorine, , Membrane Separation Processes, Desalination.

Air Pollution and Control: Sources and classification of air pollutants; Classification, Sources and Effects of air pollutants, Sampling Methods and Measurements of Air Pollutants, Measurement and analyses of primary air pollutants SO2, NOx and SPM using high volume sampler, Ambient Air Quality Standards, Emission Standards. Meteorology and dispersion of pollutants; Basic Meteorology, Transport, Dispersion and Transformation of pollutants in Air, Adiabatic Lapse Rate, Atmospheric Stability, Dispersion of Pollutants, Air Pollution Dispersion Models, Point, Line and Area Source Models, Inversions, Plume Behaviour, Mixing Height, Plume Rise, Stack Emissions and Design. Particulate control methods; Air Pollution Control Techniques, Control of Particulate Matter, Theory and description of control devices and their applications, Equipment's and their Design, Selection of Control Equipment's, Engineering Control, Concepts of Gravity Settling Chamber, Cyclone, Fabric Filter, Electrostatic Precipitator. Gaseous and noise control methods; Control of Gaseous Pollutants-Oxides of Nitrogen and Sulphur, Sources and effects of noise pollution, Kinetics of noise, Measurement and control of noise pollution, Climate Change, Odour Removal, Atmospheric Chemistry, Photochemical Smog, Global Change-Greenhouse Effect and Global Warming, Ozone Layer Depletion, Acid Rain, Air Emissions from Wastewater Treatment Facilities and their Control.

Biological Processes I: Principles of Biological Treatment, Treatment Kinetics, Substrate Removal Efficiency, Reactor Profiles, Continuous Flow Reactors-Hydraulic and Performance Characteristics (Pulse and Step Input Response), Aerobic Systems-Aerobic Biological Treatment, Kinetics of Organics Removal, Substrate Utilization and Biomass, Growth, Monod's Kinetics, Estimation of Kinetic Parameters, Cell Yield, Sludge Settling, Nutrient Requirements, Activated Sludge Process Description and its Modifications, Process Design, Process Performance Evaluation and Troubleshooting, Extended Aeration, Design of Aeration Systems, Design of Secondary Settlers, Sludge Bulking and Foaming, Biofilm Processes, Trickling Filter, Bio-towers, Substrate Removal Attached Growth System, Rotating Biological Contactors, Oxidation Ditches, Stabilization Ponds and Aerated Lagoons- Types and their Description, Design, Operation and Maintenance, Aerobic Digestion, Sequencing batch reactor and Process Design, Wetland Treatment Systems, Membrane Bioreactor, Moving Bed Biofilm Reactor. Biological Nutrient Removal, Nitrification and Denitrification- Process Kinetics, Treatment Plants for Nitrification and Denitrification, Anaerobic Ammonium Oxidation, Biological Removal of Toxic and Recalcitrant Organic Compounds, Biological Phosphorus Removal, Treatment Plants for Phosphorus Removal.

Industrial Wastewater Treatment: Industrial Waste Survey, Waste Characterization, Treated Effluent Disposal Standards, Effects of Industrial Wastewater on Receiving Water Bodies and Municipal Sewage Treatment Plants, Wastewater Sampling techniques, Flow Measurement, Waste Management Strategies and Programs, Waste Reduction-Volume and Strength Reduction, Flow Equalization and Proportioning. pH control and Neutralization, Zero Discharge Concepts, Removal of Specific Pollutants in Industrial Effluents, Oil and Grease Removal, Removal of Inorganic and Organic Constituents, Overview of Wastewater Treatment, Processes, Removal of Cyanides and Chromium. Characteristics and Treatment of Various Industrial Effluents, Pollution Control and Case Studies in Selected, Process Industries-Chlor Alkali Industry, Electroplating Industry, Fertilizer and Tannery, Identification of treatment flow sheets and wastewater treatment for selected industries- Sugar Industry, Distillery, Brewery, Paper and Pulp, Dairy, Slaughterhouse and Petroleum Refinery.

Wastewater Treatment Plant - Design and Operation: Wastewater treatment flow sheets, Bar Screens- Design and Hydraulics, Fine Screens and Micro screens, Grit Chamber, Proportional Weir, Sedimentation Tanks- Inlet and Outlet Design, Flow Distribution, Biological Waste Treatment- Activated Sludge Process, Extended Aeration, Bio-filter, UASB Reactor, Fluidized/Expanded Bed System, Ponds and Lagoon Design, Design of Nitrogen and Phosphorus Removal System, Disinfection Systems, Sludge Drying Beds.

Biological Processes II: Bioreactor Engineering, Anaerobic Treatment Fundamentals, Applications, Process Monitoring and Control, Kinetics of Anaerobic Treatment, Application of Anaerobic Digestion to Waste Treatment, Conversion, Environmental Factors**.** Anaerobic Treatment Processes, pH value and Stability in Anaerobic Digester, Suspended Growth and Fixed Film Processes, Anaerobic Process Design**,** Anaerobic Contact Process, Fixed Film Anaerobic Reactor Design, UASB Process Design for various types of Wastewaters, Anaerobic Lagoons**,** Anaerobic Sludge Digestion, Post Treatment of Effluents from Anaerobic Reactors, Refractory Organics, Biogas Utilization, Selected case studies.

Water Treatment Plant-Design and Operation: Treatment flow sheets, Mass balance calculations, Treatment Plant Hydraulics, Head Loss Types and Calculations, Manifold Hydraulics, Flow measurement. Population Forecasting, Water Use and Demand, Intake Facilities, Design of Aeration Systems. Design of Chemical Mixing, Flocculation Process Design, Filter Design, Ion Exchange Process and Equipment Design. Sedimentation Tank Design, Membrane Unit Design, Chemical Precipitation, Disinfection and Sludge Handling.

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