बिहार राज्य प्रदूषण नियंत्रण पर्षद्–अभियंत्रण संवर्ग (नियुक्ति एवं सेवा) विनियमावली, 2023 के अन्तर्गत सहायक पर्यावरण अभियंता के पद पर नियोजन हेतु लिखित परीक्षा का पाठ्यक्रम (सिलेबस) निर्धारण हेतु आहूत बैठक का वृत।

बैठक की तिथि एवं समयः 08.09.2023 को अपराह्न 4:00 बजे।
बैठक स्थलः पर्षद् का संवाद कक्ष।

बैठक में पाठ्यक्रम (सिलेबस) कमिटि के निम्नलिखित सदस्यों द्वारा भाग लिया गयाः–

1) प्रो० (डा०) रामाकर झा, सिविल इंजीनियरिंग विभाग, राष्ट्रीय प्रौद्योगिकी संस्थान, पटना;
2) प्रो० (डा०) सरोज सारंगी, मैकेनिकल इंजीनियरिंग विभाग, राष्ट्रीय प्रौद्योगिकी संस्थान, पटना;
3) प्रो० (डा०) माला डे, इलेक्ट्रिकल इंजीनियरिंग विभाग, राष्ट्रीय प्रौद्योगिकी संस्थान, पटना;
4) असि० प्रो० (डा०) प्रधी राजीव, सिविल एण्ड इन्वायरमेंटल इंजीनियरिंग विभाग, भारतीय प्रौद्योगिकी संस्थान, बिहटा, पटना;
5) असि० प्रो० (डा०) जोस वी. परमबिल, केमिकल एण्ड बायोकेमिकल इंजीनियरिंग विभाग, भारतीय प्रौद्योगिकी संस्थान, बिहटा, पटना; एवं
6) श्री एस० चन्द्रशेखर, सदस्य सचिव, बिहार राज्य प्रदूषण नियंत्रण पर्षद्, पटना।

बैठक में उपस्थित सभी माननीय सदस्यों को पर्षद् के सदस्य सचिव द्वारा स्वागत् किया गया तथा बिहार राज्य प्रदूषण नियंत्रण पर्षद्–अभियंत्रण संवर्ग (नियुक्ति एवं सेवा) विनियमावली, 2023 के विभिन्न प्रावधानों के प्रसंग में सभी सदस्यों को अवगत कराया गया। सहायक पर्यावरण अभियंता पद के उम्मीदवार के पास शैक्षणिक योग्यता–रसायन/असैनिक/यांत्रिकी/विद्युत/पर्यावरणीय अभियांत्रिकी में स्नातक डिग्री/समकक्ष डिग्री (B.E/B.Tech/A.M.I.E) एवं पर्षद् द्वारा पद के लिए समय–समय पर निर्धारित कोई अन्य योग्यता एवं अनुभव अवश्य होना चाहिए (A candidate must hold a Bachelor's degree or equivalent (B.E/B.Tech/A.M.I.E) in Chemical/ Civil/ Mechanical/ Electrical/ Environmental Engineering and possess any other qualification and experience as notified by the Board for the post from time to time)।

सहायक पर्यावरण अभियंता के पद पर नियोजन हेतु लिखित प्रतियोगिता परीक्षा आयोजन के लिए पाठ्यक्रम (सिलेबस) इत्यादि निर्धारण हेतु उपस्थित सदस्यों से विस्तृत विमर्श हुआ एवं उनसे सुझाव आमंत्रित किया गया।

राष्ट्रीय प्रौद्योगिकी संस्थान एवं भारतीय प्रौद्योगिकी संस्थान के उपस्थित माननीय सदस्यों द्वारा सहायक पर्यावरण अभियंता के पद पर नियोजन हेतु लिखित प्रतियोगिता परीक्षा आयोजन के लिए पाठ्यक्रम (सिलेबस) एवं अन्तर्वीक्षा का अंक निम्नवत् अनुमोदित किया गयाः–

Marks Distribution for Written Test & Interview

Sl. No.	Subject	Duration	No. of objective & Multiple Choice Question	Marks	Negative Marking
1	**Paper-I** i. General Aptitude ii. Engineering Mathematics	2 hrs.	50 50	50 50	i. There are four alternative answers for the answers to every question. For each question for which a wrong answer has been given by the candidate, one-third (0.33) of the marks assigned to that question will be deducted as penalty. ii. If a candidate gives
		Sub-Total	100	100	
3	**Paper-II** The Subject of the Paper (Chemical/Civil/Electrical/ Mechanical/Environmental Engineering)	2 hrs.	100	300	

					more than one answer, it will be treated as wrong answer even if one of the given answers happen to be correct and there will be same penalty as above for that question. iii. If a question is left blank i.e. no answer is given by the candidate, there will be no penalty for that question.
4	Interview		-	50	
			Total	**450**	

Syllabus for Written Test

Sl. No.	Paper-I	Syllabus
1	General Aptitude	Fill in the blanks, Verbal Reasoning, Sentence Completion, Grammar, Syllogisms, Jumbled Paragraphs, Parts of Speech, Phrases Modifiers, Data Interpretation, Logical Reasoning.
2	Engineering Mathematics	**Linear Algebra:** Matrix algebra, systems of linear equations, eigenvalues and eigenvectors. **Calculus:** Functions of single variable, limit, continuity and differentiability, mean value theorems, indeterminate forms; evaluation of definite and improper integrals; double and triple integrals; partial derivatives, total derivative, Taylor series (in one and two variables), maxima and minima, Fourier series; gradient, divergence and curl, vector identities, directional derivatives, line, surface and volume integrals, applications of Gauss, Stokes and Green's theorems. **Differential Equations:** First order equations (linear and nonlinear); higher order linear differential equations with constant coefficients. **Probability and Statistics:** Definitions of probability, sampling theorems, conditional probability; mean, median, mode and standard deviation; random variables, binomial, Poisson and normal distributions. Hypothesis testing (t-test). **Numerical Methods:** Numerical solutions of linear and non-linear algebraic equations; integration by trapezoidal and Simpson's

		rules; single and multi-step methods for differential equations.
Sl. No.	**Paper-II**	**Syllabus**
1	Subject Paper: Chemical Engineering	Annexure-I
	Subject Paper: Civil Engineering	Annexure-II
	Subject Paper: Mechanical Engineering	Annexure-III
	Subject Paper: Electrical Engineering	Annexure-IV
	Subject Paper: Environmental Engineering	Annexure-V

अनुलग्नकः पाठ्यक्रम (सिलेबस)–Annexure-I, II, III, IV एवं V

Mala De 18/10/23
(माला डे)
इलेक्ट्रिकल इंजीनियरिंग विभाग
राष्ट्रीय प्रौद्योगिकी संस्थान
पटना

18-10-2023
(सरोज सारंगी)
मैकेनिकल इंजीनियरिंग विभाग
राष्ट्रीय प्रौद्योगिकी संस्थान
पटना

Ramkar Jha 18/10/20
(रामाकर झा)
सिविल इंजीनियरिंग विभाग
राष्ट्रीय प्रौद्योगिकी संस्थान
पटना

17/10/23
(एस0 चन्द्रशेखर)
सदस्य सचिव, बिहार राज्य
प्रदूषण नियंत्रण पर्षद्
पटना

18/10/2023
(जोस वी. परमबिल)
केमिकल एण्ड बायोकेमिकल
इंजीनियरिंग विभाग भारतीय
प्रौद्योगिकी संस्थान
बिहटा, पटना

Pradhi Rajeev 18/10/20
(प्रधी राजीव)
सिविल एण्ड इन्वायरमेंटल
इंजीनियरिंग विभाग
भारतीय प्रौद्योगिकी संस्थान
बिहटा, पटना

बिहार राज्य प्रदूषण नियंत्रण पर्षद्, परिवेश भवन, पाटलीपुत्रा औद्योगिक क्षेत्र, पटना

ज्ञापांकः 2554 पटना, दिनांकः 25/10/23

प्रतिलिपिः सभी संबंधित सदस्यों को सूचनार्थ प्रेषित।

20/10/23
(एस0 चन्द्रशेखर)
सदस्य सचिव

ANNEXURE-I

Syllabus for written examination for the post of
'Assistant Environmental Engineer'
in Bihar State Pollution Control Board

CHEMICAL ENGINEERING

Section 1: Process Calculations and Thermodynamics

Steady and unsteady state mass and energy balances including multiphase, multi-component, reacting and non-reacting systems. Use of tie components; recycle, bypass and purge calculations;Gibb's phase rule and degree of freedom analysis.

First and Second laws of thermodynamics. Applications of first law to close and open systems. Second law and Entropy. Thermodynamic properties of pure substances: Equation of State and residual properties, properties of mixtures: partial molar properties, fugacity, excess properties and activity coefficients; phase equilibria: predicting VLE of systems; chemical reaction equilibrium.

Section 2: Fluid Mechanics and Mechanical Operations

Fluid statics, surface tension, Newtonian and non-Newtonian fluids, transport properties, shell- balances including differential form of Bernoulli equation and energy balance, equation of continuity, equation of motion, equation of mechanical energy, Macroscopic friction factors, dimensional analysis and similitude, flow through pipeline systems, velocity profiles, flow meters, pumps and compressors, elementary boundary layer theory, flow past immersed bodies including packed and fluidized beds, Turbulent flow: fluctuating velocity, universal velocity profile and pressure drop.

Particle size and shape, particle size distribution, size reduction and classification of solid particles; free and hindered settling; centrifuge and cyclones; thickening and classification, filtration, agitationand mixing; conveying of solids.

Section 3: Heat Transfer

Equation of energy, steady and unsteady heat conduction, convection and radiation, thermalboundary layer and heat transfer coefficients, boiling, condensation and evaporation; types of heat exchangers and evaporators and their process calculations; design of double pipe, shell and tube heat exchangers, and single and multiple effect evaporators.

Section 4: Mass Transfer

Fick's laws, molecular diffusion in fluids, mass transfer coefficients, film, penetration and surface renewal theories; momentum, heat and mass transfer analogies; stage-wise and continuous contacting and stage efficiencies; HTU & NTU concepts; design and operation of equipment for distillation, absorption, leaching, liquid-liquid extraction, drying, humidification, dehumidification andadsorption, membrane separations(micro-filtration, ultra-filtration, nano-filtration and reverse osmosis).

Section 5: Chemical Reaction Engineering

Theories of reaction rates; kinetics of homogeneous reactions, interpretation of kinetic data, single and multiple reactions in ideal reactors, kinetics of enzyme reactions (Michaelis-Mentenand Monodmodels), non-ideal reactors; residence time distribution, single parameter model; non-isothermal reactors; kinetics of heterogeneous catalytic reactions; diffusion effects in catalysis; rate andperformance equations for catalyst deactivation.

Section 6: Instrumentation and Process Control

Measurement of process variables; sensors and transducers; P&ID equipment symbols; process modeling and linearization, transfer functions and dynamic responses of various systems, systems with inverse response, process reaction curve, controller modes (P, PI, and PID); control valves; transducer dynamics; analysis of closed loop systems including stability, frequency response, controller tuning, cascade and feed forward control.

Section 7: Plant Design and Economics

Principles of process economics and cost estimation including depreciation and total annualized cost, cost indices, rate of return, payback period, discounted cash flow, optimization in process design and sizing of chemical engineering equipments such as heat exchangers and multistage contactors.

Section 8: Chemical Technology

Inorganic chemical industries (sulfuric acid, phosphoric acid, chlor-alkali industry), fertilizers (Ammonia, Urea, SSP and TSP); natural products industries (Pulp and Paper, Sugar, Oil, and Fats); petroleum refining and petrochemicals; polymerization industries (polyethylene, polypropylene, PVC and polyester synthetic fibers).

17/10/23

(S. Chandrasekar)
Member Secretary
Bihar State Pollution Control Board
Patna

18/10/2023

(Jose V Parambil)
Deptt. of Chemical & Bio-Chemical Engineering
IIT, Bihta, Patna

ANNEXURE-II

Syllabus for written examination for the post of
'Assistant Environmental Engineer'
in Bihar State Pollution Control Board

CIVIL ENGINEERING

Section 1: Structural Engineering

Engineering Mechanics: System of forces, free-body diagrams, equilibrium equations; Internalforces in structures; Frictions and its applications; Centre of mass; Free Vibrations of undamped SDOF system.

Solid Mechanics: Bending moment and shear force in statically determinate beams; Simple stress and strain relationships; Simple bending theory, flexural and shear stresses, shear centre; Uniform torsion, Transformation of stress; buckling of column, combined and direct bending stresses.

Structural Analysis: Statically determinate and indeterminate structures by force/ energy methods; Method of superposition; Analysis of trusses, arches, beams, cables and frames; Displacement methods: Slope deflection and moment distribution methods; Influence lines; Stiffness and flexibility methods of structural analysis.

Construction Materials and Management: Construction Materials: Structural Steel – Composition, material properties and behaviour; Concrete - Constituents, mix design, short-term and long-term properties. Construction Management: Types of construction projects; Project planning and network analysis - PERT and CPM; Cost estimation.

Concrete Structures: Working stress and Limit state design concepts; Design of beams, slabs, columns; Bond and development length; Prestressed concrete beams.

Steel Structures: Working stress and Limit state design concepts; Design of tension and compression members, beams and beam- columns, column bases; Connections - simple and eccentric, beam-column connections, plate girders and trusses; Concept of plastic analysis - beamsand frames.

Section 2: Geotechnical Engineering

Soil Mechanics: Three-phase system and phase relationships, index properties; Unified and Indian standard soil classification system; Permeability - one dimensional flow, Seepage through soils – two - dimensional flow, flow nets, uplift pressure, piping, capillarity, seepage force; Principle of effective stress and quicksand condition; Compaction of soils; One-dimensional consolidation, time rate of consolidation; Shear Strength, Mohr's circle, effective and total shear strength parameters, Stress-Strain characteristics of clays and sand; Stress paths.

Foundation Engineering: Sub-surface investigations - Drilling bore holes, sampling, plate load test, standard penetration and cone penetration tests; Earth pressure theories - Rankine and Coulomb; Stability of slopes – Finite and infinite slopes, Bishop's method; Stress distribution in soils – Boussinesq's theory; Pressure bulbs, Shallow foundations – Terzaghi's and Meyerhoff's bearing capacity theories, effect of water table; Combined footing and raft foundation; Contact pressure; Settlement analysis in sands and clays; Deep foundations – dynamic and static formulae, Axialload capacity of piles in sands and clays, pile load test, pile under lateral loading, pile group efficiency, negative skin friction.

Section 3: Water Resources Engineering

Fluid Mechanics: Properties of fluids, fluid statics; Continuity, momentum and energy equations and their applications; Potential flow, Laminar and turbulent flow; Flow in pipes, pipe networks; Concept of boundary layer and its growth; Concept of lift and drag.

Hydraulics: Forces on immersed bodies; Flow measurement in channels and pipes; Dimensional analysis and hydraulic similitude; Channel Hydraulics - Energy-depth relationships, specific energy,critical flow, hydraulic jump, uniform flow, gradually varied flow and water surface profiles.

Hydrology: Hydrologic cycle, precipitation, evaporation, evapo-transpiration, watershed, infiltration, unit hydrographs, hydrograph analysis, reservoir capacity, flood estimation and routing, surface run-off models, ground water hydrology - steady state well hydraulics and aquifers; Application of Darcy's Law.

Irrigation: Types of irrigation systems and methods; Crop water requirements - Duty, delta, evapo- transpiration; Gravity Dams and Spillways; Lined and unlined canals, Design of weirs on permeable foundation; cross drainage structures.

Section 4: Environmental Engineering

Water and Waste Water Quality and Treatment: Basics of water quality standards – Physical, chemical and biological parameters; Water quality index; Unit processes and operations; Water requirement; Water distribution system; Drinking water treatment.

Sewerage system design, quantity of domestic wastewater, primary and secondary treatment. Effluent discharge standards; Sludge disposal; Reuse of treated sewage for different applications.

Air Pollution: Types of pollutants, their sources and impacts, air pollution control, air quality standards, Air quality Index and limits.

Municipal Solid Wastes: Characteristics, generation, collection and transportation of solid wastes, engineered systems for solid waste management (reuse/ recycle, energy recovery, treatment and disposal).

Section 5: Transportation Engineering

Transportation Infrastructure: Geometric design of highways - cross-sectional elements, sightdistances, horizontal and vertical alignments.

Geometric design of railway Track – Speed and Cant.

Concept of airport runway length, calculations and corrections; taxiway and exit taxiway design.

Highway Pavements: Highway materials - desirable properties and tests; Desirable properties of bituminous paving mixes; Design factors for flexible and rigid pavements; Design of flexible and rigid pavement using IRC codes.

Traffic Engineering: Traffic studies on flow and speed, peak hour factor, accident study, statistical analysis of traffic data; Microscopic and macroscopic parameters of traffic flow, fundamental relationships; Traffic signs; Signal design by Webster's method; Types of intersections; Highway capacity.

Section 6: Geomatics Engineering

Principles of surveying; Errors and their adjustment; Maps - scale, coordinate system; Distance and angle measurement - Levelling and trigonometric levelling; Traversing and triangulation survey; Total station; Horizontal and vertical curves.

Photogrammetry and Remote Sensing - Scale, flying height; Basics of remote sensing and GIS.

17/10/23

(S. Chandrasekar)
Member Secretary
Bihar State Pollution Control Board
Patna

(Ramakar Jha) 18/10/2023
Deptt. of Civil Engineering
NIT, Patna

ANNEXURE-III

Syllabus for written examination for the post of 'Assistant Environmental Engineer' in Bihar State Pollution Control Board

MECHANICAL ENGINEERING

Section 1: Applied Mechanics and Design

Engineering Mechanics: Free-body diagrams and equilibrium; friction and its applications including rolling friction, belt-pulley, brakes, clutches, screw jack, wedge, vehicles, etc.; trusses and frames; virtual work; kinematics and dynamics of rigid bodies in plane motion; impulse and momentum (linear and angular) and energy formulations; Lagrange's equation.

Mechanics of Materials: Stress and strain, elastic constants, Poisson's ratio; Mohr's circle for plane stress and plane strain; thin cylinders; shear force and bending moment diagrams; bending and shear stresses; concept of shear centre; deflection of beams; torsion of circular shafts; Euler's theory of columns; energy methods; thermal stresses; strain gauges and rosettes; testing of materials with universal testing machine; testing of hardness and impact strength.

Theory of Machines: Displacement, velocity and acceleration analysis of plane mechanisms; dynamic analysis of linkages; cams; gears and gear trains; flywheels and governors; balancing of reciprocating and rotating masses; gyroscope.

Vibrations: Free and forced vibration of single degree of freedom systems, effect of damping; vibration isolation; resonance; critical speeds of shafts.

Machine Design: Design for static and dynamic loading; failure theories; fatigue strength and the S-N diagram; principles of the design of machine elements such as bolted, riveted and welded joints; shafts, gears, rolling and sliding contact bearings, brakes and clutches, springs.

Section 2: Fluid Mechanics and Thermal Sciences

Fluid Mechanics: Fluid properties; fluid statics, forces on submerged bodies, stability of floating bodies; control-volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum; Bernoulli's equation; dimensional analysis; viscous flow of incompressible fluids, boundary layer, elementary turbulent flow, flow through pipes, head losses inpipes, bends and fittings; basics of compressible fluid flow.

Heat-Transfer: Modes of heat transfer; one dimensional heat conduction, resistance concept and electrical analogy, heat transfer through fins; unsteady heat conduction, lumped parameter system, Heisler's charts; thermal boundary layer, dimensionless parameters in free and forced convective heat transfer, heat transfer correlations for flow over flat plates and through pipes, effect of turbulence; heat exchanger performance, LMTD and NTU methods; radiative heat transfer, Stefan-Boltzmann law, Wien's displacement law, black and grey surfaces, view factors, radiation network analysis

Thermodynamics: Thermodynamic systems and processes; properties of pure substances, behavior of ideal and real gases; zeroth and first laws of thermodynamics, calculation of work and heat in various processes; second law of thermodynamics; thermodynamic property charts and tables, availability and irreversibility; thermodynamic relations.

Applications: *Power Engineering*: Air and gas compressors; vapour and gas power cycles, concepts of regeneration and reheat. *I.C. Engines*: Air-standard Otto, Diesel and dual cycles. *Refrigeration and air-conditioning*: Vapour and gas refrigeration and heat pump cycles; properties of moist air, psychrometric chart, basic psychrometric processes. *Turbomachinery*: Impulse and reaction principles, velocity diagrams, Pelton-wheel, Francis and Kaplan turbines; steam and gas turbines.

Section 3: Materials, Manufacturing and Industrial Engineering

Engineering Materials: Structure and properties of engineering materials, phase diagrams, heat treatment, stress-strain diagrams for engineering materials.

Casting, Forming and Joining Processes: Different types of castings, design of patterns, moulds and cores; solidification and cooling; riser and gating design. Plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk (forging, rolling, extrusion, drawing) and sheet (shearing, deep drawing, bending) metal forming processes; principles of powder metallurgy. Principles of welding, brazing, soldering and adhesive bonding.

Machining and Machine Tool Operations: Mechanics of machining; basic machine tools; single and multi-point cutting tools, tool geometry and materials, tool life and wear; economics of machining; principles of non-traditional machining processes; principles of work holding, jigs and fixtures; abrasive machining processes; NC/CNC machines and CNC programming.

Metrology and Inspection: Limits, fits and tolerances; linear and angular measurements; comparators; interferometry; form and finish measurement; alignment and testing methods; tolerance analysis in manufacturing and assembly; concepts of coordinate-measuring machine (CMM).

Computer Integrated Manufacturing: Basic concepts of CAD/CAM and their integration tools; additive manufacturing.

Production Planning and Control: Forecasting models, aggregate production planning, scheduling,materials requirement planning; lean manufacturing.

Inventory Control: Deterministic models; safety stock inventory control systems.

Operations Research: Linear programming, simplex method, transportation, assignment, networkflow models, simple queuing models, PERT and CPM.

17/10/23

(S. Chandrasekar)
Member Secretary
Bihar State Pollution Control Board
Patna

18.10.2023

(Saroj Sarangi)
Deptt. of Mechanical Engineering
NIT, Patna

ANNEXURE-IV

Syllabus for written examination for the post of
'Assistant Environmental Engineer'
in Bihar State Pollution Control Board

ELECTRICAL ENGINEERING

Section 1: Electric circuits

Network Elements: ideal voltage and current sources, dependent sources, R, L, C, elements; Network solution methods: KCL, KVL, Node and Mesh analysis; Network Theorems: Thevenin's, Norton's, Superposition and Maximum Power Transfer theorem; Transient response of dc and ac networks, sinusoidal steady-state analysis, resonance, two port networks, balanced three phase circuits, star-delta transformation, complex power and power factor in ac circuits.

Section 2: Electromagnetic Fields

Coulomb's Law, Electric Field Intensity, Electric Flux Density, Gauss's Law, Divergence, Electric field and potential due to point, line, plane and spherical charge distributions, Effect of dielectric medium, Capacitance of simple configurations, Biot-Savart's law, Ampere's law, Curl, Faraday's law, Lorentz force, Inductance, Magnetomotive force, Reluctance, Magnetic circuits, Self and Mutual inductance of simple configurations.

Section 3: Signals and Systems

Representation of continuous and discrete time signals, shifting and scaling properties, linear time invariant and causal systems, Fourier series representation of continuous and discrete time periodic signals, sampling theorem, Applications of Fourier Transform for continuous and discrete time signals, Laplace Transform and Z transform. R.M.S. value, average value calculation for any general periodic waveform.

Section 4: Electrical Machines

Single phase transformer: equivalent circuit, phasor diagram, open circuit and short circuit tests, regulation and efficiency; Three-phase transformers: connections, vector groups, parallel operation; Auto-transformer, Electromechanical energy conversion principles; DC machines: separately excited, series and shunt, motoring and generating mode of operation and their characteristics, speed control of dc motors; Three-phase induction machines: principle of operation, types, performance, torque- speed characteristics, no-load and blocked-rotor tests, equivalent circuit, starting and speed control; Operating principle of single-phase induction motors; Synchronous machines: cylindrical and salient pole machines, performance and characteristics, regulation and parallel operation of generators, starting of synchronous motors; Typesof losses and efficiency calculations of electric machines.

Section 5: Power Systems

Basic concepts of electrical power generation, ac and dc transmission concepts, Models and performance of transmission lines, underground cables, Economic Load Dispatch (with and without considering transmission losses), Series and shunt compensation, Electric field distribution and insulators, Distribution systems, Per-unit quantities, Bus admittance matrix, Gauss-Seidel and Newton-Raphson load flow methods, Power factor correction, Symmetrical components, Symmetrical and unsymmetrical fault analysis, Principles of over-current, differential, directional and distance protection; Circuit breakers, System stability concepts, Equal area criterion.

Section 6: Control Systems

Mathematical modelling and representation of systems, Feedback principle, transfer function, Block diagrams and Signal flow graphs, Transient and Steady-state analysis of linear time invariant systems, Stability analysis using Routh-Hurwitz and Nyquist criteria, Bode plots, Root loci, Lag, Lead and Lead-Lag compensators; P, PI and PID controllers; State space model, Solution of state equations of LTI systems

Section 7: Electrical and Electronic Measurements

Bridges and Potentiometers, Measurement of voltage, current, power, energy and power factor; Instrument transformers, Digital voltmeters and multi-meters, Phase, Time and Frequency measurement; Oscilloscopes, Error analysis.

Section 8: Analog and Digital Electronics

Simple diode circuits: clipping, clamping, rectifiers; Amplifiers: biasing, equivalent circuit and frequency response; oscillators and feedback amplifiers; operational amplifiers: characteristics and applications; single stage active filters, Active Filters: Sallen Key, Butterwoth, VCOs and timers, combinatorial and sequential logic circuits, multiplexers, demultiplexers, Schmitt triggers, sample and hold circuits, A/D and D/A converters.

Section 9: Power Electronics

Static V-I characteristics and firing/gating circuits for Thyristor, MOSFET, IGBT; DC to DC conversion: Buck, Boost and Buck-Boost Converters; Single and three-phase configuration of uncontrolled rectifiers; Voltage and Current commutated Thyristor based converters; Bidirectional ac to dc voltage source converters; Magnitude and Phase of line current harmonics for uncontrolled and thyristor based converters; Power factor and Distortion Factor of ac to dc converters; Single-phase and three- phase voltage and current source inverters, sinusoidal pulse width modulation.

17/10/23

(S. Chandrasekar)
Member Secretary
Bihar State Pollution Control Board
Patna

18/10/23

(Mala De)
Deptt. of Electrical Engineering
NIT, Patna

ANNEXURE-V

Syllabus for written examination for the post of 'Assistant Environmental Engineer' in Bihar State Pollution Control Board

ENVIRONMENTAL ENGINEERING

Section 1: Environmental Chemistry

Fundamentals of Environmental Chemistry: Covalent and ionic bonding; Chemical equations, concentration and activity; Structure and chemistry of organic molecules; Radioactivity of elements; Chemical equilibria; Thermodynamics and kinetics of chemical reactions.

Principles of water chemistry: Water quality parameters and their measurement; Acid-base equilibria; Buffer solution; Carbonate system; Solubility of gases in water; Complexation, precipitation, and redox reactions; Inorganic and organic contaminantsin water and their speciation.

Soil chemistry;Organic matter, nitrogen, phosphorous, potassium, cation exchange capacity, base saturation, and sodium absorption ratio.

Atmospheric Chemistry: Composition of the atmosphere; Reactivity of trace substances in the atmosphere; Urban atmosphere—smog and particulate pollution; Chemistry of ozone formation; Chemistry of stratosphere.

Section 2: Environmental Microbiology

Prokaryotic and eukaryotic microorganisms; Characteristics of diverse groups of microorganisms; Classification of microorganisms; Microbial diversity; Plant-microbe and soil-microbe interactions; Role of microorganisms in wastewater treatment, bioremediation and biogeochemical cycling.

Cell chemistry and cell biology: Structure of proteins, nucleic acid (DNA & RNA), lipids and polysaccharides; Bonds in biomolecules; Stereoisomerism in biomolecules; Structure of cell; Structure and function of cytoplasmic membrane, cell wall, outer membrane, glycocalyx, chromosomes, endospores, storage products, mitochondria and chloroplasts.

Microbial metabolism: Anabolism and catabolism; Phosphorylation; Glycolysis; TCA cycle; Electron transport chain; Fermentation; Anaerobic respiration; Energy balances; Enzymes and Enzyme kinetics.

Growth and control of microorganisms: Bacterial nutrition and growth; Specific growth rate and doubling time; Monod's model; Types of culture media; Batch and continuous culture; Effects of environmental factors on growth; Control of microbes using physical and chemical methods.

Microbiology and health: Pathogens and modes of transmission; Indicator organisms; Quantification of coliforms using MPN and membrane filtration techniques.

Section 3: Water Resources and Environmental Hydraulics

Global Water Resources: Structure, properties and distribution of water; Water quality; Threats to water resources; Water conservation.

Surface Water Resources: Hydrological cycle and water balance - precipitation, infiltration, evapotranspiration, runoff; Flow hydrographs; Unit hydrographs; Stage-discharge relationship; Reservoir capacity; Reservoir and channel routing; Surface run-off models; Surface water management; Rain water harvesting and storage.

Groundwater Resources: Geologic formations as aquifers; Vadose and saturated zones; Confined and unconfined aquifers and their parameters - porosity, permeability, transmissivity and storage coefficient; Darcy's law and applications; Steady state well hydraulics.

Environmental Hydraulics: Concepts of mechanics; Properties of fluids; Pressure measurement; Hydrostatic force on surfaces; Buoyancy and flotation; Laminar and turbulent flow; Flow through pipes; Pipe networks; Boundary layer theory; Forces on immersed bodies; Flow measurement in channels and pipes; Kinematics of flow; Continuity, momentum and energy equations; Channel hydraulics - specific energy, critical flow, hydraulic jump, rapid and gradually varied flow; Design of lined and unlined channels.

Section 4: Water & Wastewater Treatment and Management

Water and wastewater quality parameters; Eutrophication and thermal stratification in lakes; River pollution-Oxygen sag curve.

Water treatment methods-screening, sedimentation with and without coagulation, filtration, desalination, disinfection; Water distribution and storage

Point and non-point sources of wastewater; Population forecasting methods; Design of sewer and storm water sewers; Sewer appurtenances; Preliminary, primary, secondary and tertiary sewage treatment; Sludge generation, processing and disposal methods; Sewage farming.

Sources and characteristics of industrial effluents; Concept of Common Effluent Treatment Plants (CETP); Wastewater recycling and zero liquid discharge.

Kinetics and reactor design: Mass and energy balance, Order and rate of reactions, Batch reactors, Completely mixed flow reactors, Plug flow reactors.

Section 5: Air and Noise Pollution

Structure of the atmosphere; Natural and anthropogenic sources of pollution; Atmospheric sources, sinks, transport; Indoor air pollution; Effects on health and environment; Air pollution: gases and particulate matter; Air quality standards; Primary and secondary pollutants; Criteria pollutants, ambient and source standards, air quality indices, visibility.

Particulate pollutants: measurement and control methods; Control of particulate air pollutants using gravitational settling chambers, cyclone separators, wet collectors, fabric filters (Bag-house filter), electrostatic precipitators (ESP).

Gaseous Pollutants: Measurement and control methods; Control of gaseous contaminants: absorption, adsorption, condensation and combustion; Control of sulphur oxides, nitrogen oxides, carbon monoxide, and hydrocarbons; Vapour-liquid and vapour-solid equilibria; Diffusion, Fick's law and interfacial mass transfer.

Automotive emission controls, fuel quality, diesel particulate filters, catalytic convertors.

Air quality management: Point, line and area sources; Inventory; Influence of meteorology - wind rose diagrams, stability, mixing height, topography, dispersion modelling, monitoring.

Noise pollution: Sources; Health effects; Standards; Measurement and control methods.

Section 6: Solid and Hazardous Waste Management

Integrated solid waste management; Waste hierarchy; Rules and regulations for solid waste management in India.

Municipal solid waste management: Sources, generation, characteristics, collection and transportation, waste processing and disposal (including reuse options, biological methods, energy recovery processes and landfilling).

Hazardous waste management: Characteristics, generation, fate of materials in the environment, treatment and disposal.

Soil contamination and leaching of contaminants into groundwater.

Management of biomedical waste, plastic waste and E-waste: Sources, generation and characteristics; Waste management practices including storage, collection and transfer.

Section 7: Global and Regional Environmental Issues

Global effects of air pollution – Greenhouse gases, global warming, climate change, urban heat islands, acid rain, ozone hole.

Ecology and various ecosystems; Biodiversity; Factors influencing increase in population, energy consumption, and environmental degradation.

Section 8: Environmental Management and Sustainable Development

Environmental Management Systems; ISO14000 series; Environmental auditing: Environmental Impact Assessment; Life cycle assessment; Human health risk assessment

Environmental Law and Policy–Objectives; Polluter pays principle, Precautionary principle; The Water and Air Acts with amendments; The Environment (Protection) Act (EPA) 1986; National Green Tribunal Act, 2010; National Environment Policy; Principles of International Law and International treaties.

Energy and Environment: Energy sources–overview of resources and reserves; Renewable and non-renewable energy sources; Energy-Environment nexus.

Sustainable Development: Definition and concepts of sustainable development; Sustainable development goals; Hurdles to sustainability; Environment and economics.

17/10/23

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