Nepal Engineering Council Registration Examination

Environmental Engineering Syllabus (AEnE)

Chapters 1-4 are fundamentals/principles a concepts of environment engineering; chapters 5-9 are related to application of engineering principles in practice; and the last (10th) chapter is related to project planning, design and implementation of project.

1. Basic Environmental Engineering (AEnE01)

1.1 Introduction: Environmental Engineering, Engineering Decisions, Major environmental parameters; Units of Measurement, Values and Dimensions, Approximations in engineering calculations, Procedure for calculations with approximations, Ecosystem and System Approach, Water cycle, Carbon cycle, Nitrogen cycle, Phosphorous cycle; Mass and Energy Transfer, Mass balance, Conservative and non-conservative substance, Steady state condition. (AEnE0101)

1.2 Environmental regulation & EIA: Environmental Laws, Regulations & Guidelines, Environmental standards (emission levels, species protection list, Environment assessment reports; Environmental Screening; Screening procedures in Nepal; Environmental Scoping; Terms of Reference; Baseline Establishment, Executing the EIA process; Options to EA (Alternatives: Types and comparison); Environmental Management Plan (EMP), Environmental Monitoring, Environmental Auditing. (AEnE0102)

1.3 Engineering survey: Fundamentals of surveying; measurements (linear distance, vertical distance, and angle and directions); topographic survey (principles and applications), hydrographic survey measurements (principles and applications). (AEnE0103)

1.4 Green engineering and sustainable design basis: Fundamental concepts of Green Engineering, Sustainable designs, Product life cycle assessment, Risk assessment, Quality management system, clean technology and cleaner production. (AEnE0104)

1.5 Estimating, costing, and valuation: types of estimates; methods of estimating; rate analysis; specifications (purpose, importance and types), valuation. (ACiE0106)

1.6 GIS and remote sensing: Fundamental of GIS, components of GIS, map, map features, map properties, coordinate system, raster and vector data, geographic data linkage and matching, Application in Environmental Engineering. (AEnE0106)

2. Basic Water Resources Engineering (ACiE03)

2.1 Fluids and their properties: types of fluids; fluid properties (e.g., mass density, specific weight, specific gravity, specific volume, viscosity, compressibility, capillarity, surface tension, cavitation and vapour pressure. (ACiE0301)

2.2 Hydrostatics: pressure and head; Pascal's law; pressure-depth relationship; manometers; pressure force and centre of pressure on submerged bodies (plane and curved surfaces); pressure diagrams; buoyancy; stability of floating/submerged bodies. (ACiE0302)

2.3 Hydro-kinematics and hydro-dynamics: classification of fluid flow; conservation of mass (continuity equation) and momentum equations and their applications; Bernoulli's equation and its application; flow in mobile boundary channel (design principles/approaches; inception motion condition; Shield diagram). (AEnE0203)

2.3 Hydro-kinematics and hydro-dynamics: classification of fluid flow; conservation of mass (continuity equation) and momentum equations and their applications; Bernoulli's equation and its application; flow measurement. (ACiE0303)

2.4 Pipe flow: types, governing equations, major and minor head losses; HGL and TEL lines; design; pipe network problems; unsteady flow in pipes and relief devices. (ACiE0304)

2.5 Open channel flow: geometrical properties; various types of flows; energy and momentum principles (Specific Energy and Specific Force); Types of gradually varied flow profiles; hydraulic jump (types, theory for horizontal and rectangular) flow in mobile boundary channel (design principles/approaches; inception motion condition; Shield diagram). (ACiE0305)

2.6 Hydrology: hydrologic cycle and water balance components; flow measurement and rating curves; hydrographs analysis and synthetic unit hydrographs; rainfall-runoff analysis; flood hydrology (flood frequency analysis and design flood); groundwater hydrology. (ACiE0306)

3. Structural Mechanics (AEnE03)

3.1 Shear forces and bending moments: Axial forces, shear forces, and bending moments; loads and load superposition; relationship and diagram Interpretation (AF, SF, BM). (ACiE0401)

3.2 Stress and strain analysis: normal and shear stresses; principal stresses and principal planes; maximum shear stress and corresponding plane; stress-strain curves; torsion (ACiE0402)

3.3 Theory of flexure and columns: co-planar and pure bending; elastic curve; angle of rotation; radius of curvature and flexural stiffness; deflection; bending stress; Euler's formula for long column. (ACiE0403)

3.4 Determinate structures: Degree of determinacy, Energy methods, Virtual Work Method, Deflection of Beams; Influence Lines for Simple Structures, Arches, Statically Determinate Trusses, Cables of Suspended Bridges. (AEnE0304)

3.5 RCC: Working stress and limit state methods; Design of beam, T-beam design; Colum design; One- way and two-way slab design, footing design, Shear wall design, Retaining wall Design and Prestressed concrete. NS & IS codes. (AEnE0305)

3.6 Masonry and timber structures: Design principles, consideration, properties; Design of masonry structure (Nepal Building Code), Mud mortar, lime mortar and cement mortar and its properties; Design principles of timber beams and columns. NS & IS codes. (AEnE0305)

4. Bioengineering and Bioremediation (AEnE04)

4.1 Engineering geology: Rock and Soil; classification, structure, textures of Rocks; Geomorphological processes- Weathering and erosion; Geology of Nepal: Terai Zone, Siwalik Zone, Lesser Himalaya Zone, Higher Himalaya Zone, Tethys Himalaya Zone; River channel morphology; Origin, type and movement of groundwater, porosity, permeability and hydraulic transmissivity of different rocks and sediments; Different types of aquifer system of Nepal; geological Hazards: Flood, GLOF, erosion, mass movement and their Causes; Engineering Significance. (AEnE0401)

4.2 Climate science: Meteorology, Climate and Weather; Global Wind Systems; Global Weather Patterns; Clouds, Storms and Climate -Cloud Formation and Climate; Global Ocean Circulation; El Niño and the Southern Oscillation; Greenhouse gases & human emission; Outlook for the Future. (AEnE0402)

4.3 Disaster risk reduction and climate chand mitigation & adaptation: Fundamentals of DRR, Environment-development and disasters; Disaster typology and classification; Concepts of Hazard, Risk, Vulnerability, Disaster, Mitigation and Adaptation; Climate change, climate variability and implications on disaster risk; Climatic extreme events; Disaster Risk Mitigation; Disaster Risk Management; Disaster Preparedness; Mainstreaming CCA-DRR. (AEnE0403)

4.4 Bioengineering and landscape management: Integrated watershed management, problems on slopes, functions of bioengineering calculation of relative shear strength due to roots growth, nursery design criteria, green road concept in Nepal. (AEnE0404)

4.5 Small civil and vegetative structures used in bioengineering: different walls and structures used in bioengineering, grass plantation, brush layering, palisade, turfing, optimum techniques selection in bioengineering. (AEnE0405)

4.6 Bioremediation: Introduction to Bioremediation, microorganisms, contaminants; Strategies of microbial degradation and bioremediation; Bioremediation of organic and inorganic pollutants; Remediation Technologies. (AEnE0406)

5. Water Supply Engineering (AEnE05)

5.1 Fundamentals of water source and water supply schemes Importance of water, types of water, Historical development of water supply schemes, Objectives of water supply system, Components of water supply system, Schematic diagram of typical water supply system, Financing of water supply system, Sources of water, Quantity and Quality of water, Drinking Water Quality Standards and Water Treatment Objectives. (AEnE0501)

5.2 Water quality engineering and management: Aquatic ecology, water pollution, Effects of pollution; water quality standards, water quality assessment and its management; Strategies for water pollution control. (AEnE0502)

5.3 Water supply system: Site selection of intake, Classification of intake, Characteristics of intake, Design of intake and distribution systems: design of intakes; types and purposes of pipe materials, joints, valves and fittings; break pressure tanks; service reservoirs and their capacity determination; design of branch and looped water distribution systems. (AEnE0503)

5.4 Water treatment process and technologies: Objectives of water treatment, Treatment processes and impurity removal, Screening, Plain Sedimentation, Sedimentation with coagulation, Filtration, Disinfection, Softening, Miscellaneous treatments, Principals of Granular Media Filtration; Slow Sand Filtration; Rapid Gravity Filtration; Roughening Filter; Backwashing; Air Scouring; Disinfection; Sludge Treatment; Problems related to the calculation of Effective Size, Uniformity Coefficient and head loss, Advanced Water treatment Processes (Hardness Removal; Activated Carbon Filtration; Ion Exchange; Membrane Process). (AEnE0504)

5.5 Reservoirs and distribution system: System of supply, Clear water reservoirs, Service reservoirs, Capacity determination of service reservoirs, Layout of distribution system, Design of distribution system, Design of branched and looped water distribution systems, Network analysis, non-revenue water (NRW), Strategies for management of NRW. (AEnE0505)

5.6 Pumps and pumping stations: Fluid properties, pressure and head, hydraulic gradient, positive displacement and centrifugal pumps, pump and system curves; overview of pump components, pump curves, pump selection, pressure transients (surge) analysis, pumping Station Design, Sump Design, Pumping Systems design, Solar pumping system. (AEnE0506)

6. Energy Resource Engineering (AEnE06)

6.1 Energy basics: Current energy trends, demand and supply in world and Nepal, Conventional and non-conventional / renewable energy sources, HDI and its relation to energy; energy system conservation practice. (AEnE0601)

6.2 Hydropower: water turbines and hydroelectric plants, hydropower plants classification, engineering components and basic design of hydropower plant, basic design of components in hydropower. (AEnE0602)

6.3 Solar energy: solar radiation, solar thermal energy, solar cell, design of array and battery size for building and water supply schemes. (AEnE0603)

6.4 Wind and geothermal energy: availability of wind energy sources, wind turbines, wind parks, power control, power calculation from wind, sources of geothermal energy, uses of geothermal energy. (AEnE0604)

6.5 Biomass, bioenergy, hydrogen energy and fuel cell: synthetic fuels from biomass, thermo-chemical, physio-chemical and bio-chemical conversion, bio-fuel cells, basic electrochemistry, PEM fuel, SOFCs, hydrogen production and storage. (AEnE0605)

6.6 Environmental impacts of energy sources: emission hazards, battery hazards, nuclear hazards, hybrid vehicles, smart grid systems, capacitors. (AEnE0606)

7. Solid Waste Engineering **(AEnE07)**

7.1 Fundamentals of solid waste and its management: waste, solid waste, solid waste management, integrated sustainable solid waste management, Sources and composition of solid waste, types and sources of solid waste, composition of solid waste, sources and characteristics of hazardous wastes, clinical wastes. (AEnE0701)

7.2 Properties of solid waste: physical, chemical and biological properties of solid waste, proximate and ultimate analysis of solid waste, waste to energy calculations, green hydrogen from solid waste. (AEnE0702)

7.3 Solid waste collection and transportation: waste handling methods, on site and off-site waste management, methods and services of solid waste, HCS, SCS, location and design of transfer station. (AEnE0703)

7.4 Waste disposal: types of landfilling, methods of landfilling, Design of landfill sites, criteria for selection of landfill sites, waste decomposition mechanism in landfill sites, landfill leachate calculation, landfill leachate treatment technologies; Disposal of Hazardous and Special wastes. (AEnE0704)

7.5 Material recovery facilities: 3 R principles, paper plastics metals and glass recycling, composting and its types, incineration and its types, Good Recycled Products. (AEnE0705)

Governance, Act and Policies: Status of Solid waste management in Nepal, Challenges and Gaps; Solid Waste Management Act, Solid Waste Management Rules. (AEnE0706)

8. Air and Noise Pollution Control **(AEnE08)**

8.1 Introduction to air pollution control: History of Air Pollution Control in Nepal; Emissions, Transport, Receptors; Units and Standards; Effects of Air Pollution on Human Health; Air Pollution Effects on Property; Air Pollution Effects on Visibility; Air Pollution Control Laws and Regulations; Air Pollution Control practices. (AEnE0801)

8.2 Approaches for air pollution control: Alternatives; Resource Recovery; Ultimate Fate of Pollutants; Designing Air Pollution Control Systems and Equipment; Fluid Velocities in Air Pollution Control Equipment; Minimizing Volumetric Flow Rate and Pressure Drop; Efficiency, Penetration, Nines; Homogeneous and Non-homogeneous Pollutants; Basing Calculations on Inert Flowrates; Changing Volumetric Flow Rates; Acid Dew Point; Catalysts for Air Pollution Control. (AEnE0802)

8.3 Nature of particulate pollutants: Primary and Secondary Particulates; Settling Velocity and Drag Forces; Particle Size Distribution Functions; Particles in Our Bodies; Secondary Fine Particles; Behaviour of Particles in the Atmosphere, Control of Primary Particulates, VOCs, sulphur oxides, nitrogen oxides, and other criteria pollutants. (AEnE0803)

8.4 Air pollution measurements, emission estimates: A Representative Sample; Getting the Representative Sample to the Detector; Concentration Determination; Averaging; Standard Analytical Methods; Determining Pollutant Flow Rates; Isokinetic Sampling; Emission Factors; Visible Emissions. (AEnE0804)

8.5 General ideas in air pollution control: Primary and Secondary Particulates; Settling Velocity and Drag Forces; Particle Size Distribution Functions; Particles in Our Bodies; Secondary Fine Particles; Behaviour of Particles in the atmosphere. (AEnE0805)

8.6 Noise pollution: introduction, Effect of noise on people; Measurement; Noise control techniques; Standards and Guidelines. (AEnE0806)

9. Wastewater Treatment Technology **(AEnE09)**

9.1 Fundamentals of wastewater treatment: Characterization of wastewater; Effluent discharge Standards; Sewerage Systems; Sewers (combined sewers; separate systems; partially separate system; estimation of flow in sewers); Wastewater Treatment Design Flow Rates; Wastewater Treatment

(physical operations; chemical operations; biological processes); Classification of Wastewater Treatment Stages; Layout of Wastewater Treatment Plants. (AEnE0901)

9.2 Design of sewers: Introduction; shapes of sewer; sewer system design criteria; sewer hydraulics; hydraulic elements for circular sewers; partial flow diagrams; construction of sewers; construction materials. (AEnE0902)

9.3 Preliminary and primary wastewater treatment processes: Screening; grit removal; Flow equalization tank; Primary Sedimentation; Design Examples of treatment units. (AEnE0903)

9.4 Biological wastewater treatment: Process Microbiology and Kinetics of Microbial Processes; Aerobic Biological Treatment Processes; Anaerobic Biological Treatment Processes; Anoxic Processes.; Reactor types (batch, continuous, plug-flow); Types of biological treatment processes; Suspended and attached growth processes. (AEnE0904)

9.5 Suspended, attached and alternative treatment systems: Process description and design principles of Activated Sludge Process; Trickling Filters, Moving Bed Biofilm Reactors, Stabilization Ponds, Lagoons, Constructed Wetlands; Design Examples , Nutrient Removal and Resource Recovery (Phosphorus and Nitrogen Removal (Nitrification/Denitrification); Anaerobic Technologies for wastewater treatment and biogas recovery). (AEnE0905)

9.6 Decentralized wastewater treatment plants and sludge management: Septic tanks, Soak pits, Gravity Thickening, Dewatering, Stabilization; Anaerobic Digestion, Composting; Land application and Incineration. (AEnE0906)

10. Project Planning, Design and Implementation (AALL10)

10.1 Engineering drawings and its concepts: Fundamentals of standard drawing sheets, dimensions, scale, line diagram, orthographic projection, isometric projection/view, pictorial views, and sectional drawing. (AALL1001)

10.2 Engineering Economics: understanding of project cash flow; discount rate, interest and time value of money; basic methodologies for engineering economics analysis (Discounted Payback Period, NPV, IRR & MARR); comparison of alternatives, depreciation system and taxation system in Nepal. (AALL1002)

10.3 Project planning and scheduling: project classifications; project life cycle phases; project planning process; project scheduling (bar chart, CPM, PERT); resources levelling and smoothing; monitoring/evaluation/controlling. (AALL1003)

10.4 Project management: Information system; project risk analysis and management; project financing, tender and its process, and contract management. (AALL1004)

10.5 Engineering professional practice: Environment and society; professional ethics; regulatory environment; contemporary issues/problems in engineering; occupational health and safety; roles/responsibilities of Nepal Engineers Association (NEA). (AALL1005)

10.6 Engineering Regulatory Body: Nepal Engineering Council (Acts & Regulations). (AALL1006)