

## Nepal Engineering Council Registration Examination

### **Civil Engineering Syllabus (ACiE)**

Chapters 1-4 are fundamentals/principles of concepts in civil 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.

#### **1. Basic Civil Engineering (ACiE01)**

**1.1 Engineering materials:** Properties (physical, chemical, mechanical and thermal); types, characteristics, composition, selection, and usage/function of engineering materials (stones, bricks, tiles, cement, lime, timber, metals/alloys, paints/varnishes, and asphalt/bitumen/tar). (ACiE0101)

**1.2 Standards (NS & IS) and tests for civil engineering materials:** tests of brick (water absorption and compressive tests), tests of cement (consistency, setting time, soundness, and compressive strength); test of aggregate (bulking of sand); test of rebar (tensile test). (ACiE0102)

**1.3 Building technology:** Building construction technology (brick and stone masonry, carpentry, painting, plastering, concrete roofing, flooring, damp proof course); Building by laws. (ACiE0103)

**1.4 Geometric properties of sections:** Axes of symmetry; centre of gravity of different sections (e.g., built-up plane figures, standard steel sections); moment of inertia; radius of gyration (ACiE0104)

**1.5 Surveying and levelling:** Fundamentals of surveying; measurements (linear distance, vertical distance, and angle and directions); levelling; topographic survey (principles and applications); Simple circular curves, principles and applications of GPS/GIS. (ACiE0105)

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

#### **2. Soil Mechanics and Foundation Engineering (ACiE02)**

**2.1 Soil properties and laboratory tests:** tests for strength, permeability, compressibility, phase relationships; determination of index and engineering properties of soils; soil classification (descriptive, textural, ISI, MIT, USCS); boring log interpretation; sieve analysis and interpretation of results; determination of Atterberg limits of soils. (ACiE0201)

**2.2 Stresses on soil and seepage:** effective stress (factors affecting effective stress, capillary rise, and quick sand conditions); seepage analysis [Seepage pressure, flow nets and their applications]; soil compressibility (including various indices) and compaction (definition, affecting factors). (ACiE0202)

**2.3 Shear strength of soil and stability of slopes:** Concept of shear strength, principal planes and principal stresses; Mohr-Coulomb theory of shear strength; calculation of normal and shear stresses at different planes; relation of principle stress at failure condition; types of shear tests; stability of slopes. (ACiE0203)

**2.4 Soil exploration, earth pressure and retaining structures:** soil exploration (methods, planning, soil sampling and samplers, field tests, site investigation reports); earth pressure theories; stability analysis of retaining walls; techniques to increase stability of retaining walls. (ACiE0204)

**2.5 Fundamentals of foundation:** Definition, Types (Shallow and Deep), functions, factor affecting, site investigation of foundation, concept of spread and mat foundation. (ACiE0205)

**2.6 Bearing capacity and foundation settlements:** bearing capacity (types, effects of various factors); modes of foundation failure; Terzaghi's general bearing capacity theory; ultimate bearing capacity of cohesion-less and cohesive soils; consolidation (concept, types and tests); settlement (types, nature, effects and calculations) (ACiE0206)

### **3. Basic Water Resources Engineering**

**(ACiE03)**

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

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

**3.3 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)

**3.4 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)

**3.5 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)

**3.6 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)

### **4. Structural Mechanics**

**(ACiE04)**

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

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

**4.3 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)

**4.4 Determinate structures-1:** Degree of determinacy, Energy Methods, Virtual Work Method, Deflection of beams and portal frame. (ACiE0404)

**4.5 Determinate structures-2:** Influence Lines for Simple Structures with point loads and UDL; analysis of two hinged arches. (ACiE0405)

**4.6 Indeterminate structures:** Flexibility Method, Two-Hinged Parabolic Arches, Slope Deflection Method, Moment Distribution Method, Stiffness method, Influence Lines for Continuous Beams, Elementary Plastic analysis. (ACiE0406)

### **5. Design of Structures**

**(ACiE05)**

**5.1 Loads and load combinations:** Dead Load, Imposed Load, Wind Load, Snow Load, Earthquake Load. (ACiE0501)

**5.2 Concrete technology:** concrete technology (materials, properties, mix design, testing, quality control, and codes (IS and NS)). (ACiE0502)

**5.3 RCC structures-1:** working stress and limit state methods; design of beams and slabs; analysis of RC beams and slabs in bending, shear, deflection, bond and end anchorage; RCC; NS & IS codes. (ACiE0503)

**5.4 RCC structures-2:** design of columns and isolated/combined footings; pre-stressed concrete; NS & IS codes. (ACiE0504)

**5.5 Steel structures:** standard and built-up sections; design of bolted and welded connections; design of simple elements such as ties, struts, axially loaded columns, and column bases; NS and IS codes. (ACiE0505)

**5.6 Timber and masonry structures:** design principles of timber beams and columns; Design of masonry structures (Mandatory rules of thumb, Nepal Building Code (NBC), properties), Failure modes of masonry structure, mud mortar, lime mortar and cement mortar and its properties. (ACiE0506)

## **6. Water Supply, Sanitation and Environment (ACiE06)**

**6.1 Water sources, water quality and water demand:** sources of water (surface and groundwater) and their selection; impurities in water (suspended, colloidal, dissolved); hardness and alkalinity; living organisms in water; water-related diseases and prevention measures; drinking water quality standards; water demand estimation. (ACiE0601)

**6.2 Intake and distribution systems:** Types of intakes, factor affecting while selection of location of intake; 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. (ACiE0602)

**6.3 Water treatment process and technologies:** various treatment process and their purposes; screening; plain sedimentation; sedimentation with coagulation; flocculation; filtration; disinfection; softening; and miscellaneous treatments (aeration, removal of iron and manganese, removal of color /odour / taste). (ACiE0603)

**6.4 Design and construction of sewers:** estimation of quantity of waste water; sewerage system and types; design criteria of sewers; shapes of sewers; sewer materials; design of sewers for separate and combined systems; construction of sewers and sewer appurtenances. (ACiE0604)

**6.5 Treatment and disposal of wastewater:** characteristics and examination of sewage; decomposition of wastewater; BOD and COD; primary treatment processes and design of grit chamber; secondary or biological treatment process; sewage filtration; activated sludge process; oxidation ponds; waste water disposal by dilution (oxygen sag curve; Streeter Phelp's equation); waste water disposal by land treatment; sludge and solid waste disposal methods; latrine and septic tank. (ACiE0605)

**6.6 Concept of environmental assessment:** BES; IEE; EIA; government's act, rules/regulations/procedures for BES/IEE/EIA; Types of disaster and its mitigation. (ACiE0606)

## **7. Irrigation and Drainage (ACiE07)**

**7.1 Water demand estimation:** crop water and irrigation water requirements; water availability for irrigation; command areas; irrigation intensity; duty, delta and their relationship; water losses and irrigation efficiencies; effective rainfall; soil-moisture-irrigation relationship; depth and frequency of irrigation; design discharge for canals. (ACiE0701)

**7.2 Design of canals:** canal types, network and alignment; tractive force approach of canal design; design of stable canals, alluvial canals (Kennedy's and Lacey's theory), and lined canals. (ACiE0702)

**7.3 Diversion headworks:** components of headwork; seepage theories and their applications (Bligh's, Lane's, Khosla's); design of silt control structures (excluder, ejector and settling basins); design of weir/barrage (crest, length and thickness of impervious floor); design of energy dissipaters. (ACiE0703)

**7.4 River training works:** river stages and need of river training; design of river training works (guide bund and launching aprons, levees and spurs); watershed management (ACiE0704)

**7.5 Regulating and cross-drainage structures:** functions of various types of regulators, design of regulators and escapes (crest, length and thickness of impervious floor); design of pipe outlet (free and submerged); design of vertical drop (crest, length, and thickness of impervious floor); design of cross-drainage structures. (ACiE0705)

**7.6 Water logging and drainage:** causes, effects and preventive measures; design of surface and sub-surface drainage systems; (ACiE0706)

## **8. Hydropower** (ACiE08)

**8.1 Planning of hydropower projects:** power potential (gross, technical, economic) of Nepal and the world; stages of hydropower development, hydropower development in Nepal (history, policy, acts & regulation.) (ACiE0801)

**8.2 Power and energy potential study:** power and energy potentials; methods of fixing installed capacity of a plant; types of hydropower plants on various basis; components of different types of hydropower projects; reservoirs and their regulation. (ACiE0802)

**8.3 Headworks of storage plants:** components of a typical storage plant; dams (types, functions, selection, design, failure modes and remedies); stability analysis of gravity dam, seepage control and foundation treatment in dams; design of intake, spillway and energy dissipaters; gates (types and locations). (ACiE0803)

**8.4 Headworks of run-of-river (ROR) plants:** components of a typical ROR plant; design of intake; methods of bed and suspended load handling; design of settling basin (practice and concentration approach), estimation of sediment volume in settling basin, flushing of deposited sediment, estimation of flushing frequency for sediments. (ACiE0804)

**8.5 Water conveyance structures:** hydraulic tunnels, x-sections, and hydraulic design (velocity and sizing); tunnel lining; design of forebay and surge tanks; design of penstocks and pressure shaft; hydraulic transients (water hammer). (ACiE0805)

**8.6 Hydro-electric machines and powerhouse:** hydro-mechanical equipment and their functions; types of turbines and performance characteristics; selection of turbine and their specific speed; preliminary design of Francis and Pelton turbines; scroll case and draft tubes; generators (types, rating); governors; pumps and their performance characteristics; powerhouse (types, general arrangements, dimensions). (ACiE0806)

## **9. Transportation** (ACiE09)

**9.1 Highway planning and survey:** Modes of transport, history of road development in Nepal; classification of roads; road survey; highway alignment and controlling factors; evaluating alternate alignments; Road Standards of Nepal. (ACiE0901)

**9.2 Geometric design of highway:** basic design control and criteria; elements of highway cross-section; highway curves; super elevation; average and ruling gradients; stopping sight distance; design considerations for horizontal and vertical alignments, extra widening, and set back distance; design of road drainage structures; design considerations for hill roads. (ACiE0902)

**9.3 Highway materials:** types of aggregates and tests on their gradation, strength, durability; binding materials and their tests; design of asphalt mixes; evaluation of subgrade soil. (ACiE0903)

**9.4 Traffic engineering and safety:** impact of human and vehicular characteristics on traffic planning; traffic operations and regulations; traffic control devices; traffic studies (volume, speed, O&D, traffic capacity, traffic flow characteristics, parking, accident, flow); road intersections (types, configurations, design); traffic lights; factors influencing night visibility, road safety measures. (ACiE0904)

**9.5 Road pavement:** different types of pavement; design methods for flexible and rigid pavements (DOR Guidelines); loads and other factors controlling pavement design; stress due to load, temperature. (ACiE0905)

**9.6 Road construction & maintenance:** activities, techniques, tools, equipment and plants used in road construction; preparation of road subgrade; field compaction control and soil stabilization; construction of asphalt concrete layers; construction procedure for penetration macadam, bituminous bound macadam and plain cement concrete pavements; road maintenance, repair and rehabilitation. (ACiE0906)

## **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)