

## Nepal Engineering Council Registration Examination

### *Agricultural Engineering Syllabus (AAgE)*

Chapters 1-3 are fundamentals/principles a concept of agricultural engineering; chapters 4-9 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, relative equilibrium. (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. Irrigation, Drainage, and Groundwater Development**

(AAgE04)

**4.1 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)

**4.2 Design of canals and diversion headworks:** canal types and components, network and alignment; tractive force approach of canal design; design of stable canals, alluvial canals (Kennedy's and Lacey's theory), and lined canals (with economic analysis); components of weir/barrage; seepage theories and their applications (Bligh's, Lane's, Khosla's); silt control structures (excluder, ejector and settling basins); design of weir/barrage (crest, length and thickness of impervious floor); design of energy dissipaters. (AAgE0402)

**4.3 River training works:** river stages and need of river training; design of river training works (guide bund and launching aprons, and spurs); Water logging and drainage – causes, effects and preventive measures; design of surface and sub-surface drainage systems. (AAgE0403)

**4.4 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)

**4.5 Planning, management of irrigation system and on-farm water management:** General irrigation system planning; participatory irrigation management, institutional aspect, operation and maintenance of irrigation system management; methods of applying water in irrigation field; hydraulics of irrigation methods (check basin, border, strip, furrow, sprinkler, and drip). (AAgE0405)

**4.6 Groundwater development:** Aquifer characteristics and groundwater yield; groundwater exploration methods; design and selection of wells, tube well drilling methods and selection; working principle, design consideration, selection, and installation of water lifting devices and pumps (reciprocating, centrifugal, submersible, propeller, hydraulic ram, and treadle pump). (AAgE0406)

## **5. Farm Power Machine and Machinery**

**(AAgE05)**

**5.1 Farm power sources:** Sources of farm power and their utilization; animal power harness and its design parameters. (AAgE0501)

**5.2 Engine system:** Internal combustion engine (operating parameter, working cycle, difference on two stroke and four stroke cycle engine, heat balance, P-T-S relationship, engine efficiency); components involved in intake and exhaust system, working principle and components of Diesel and Petrol fuel system, Ignition system, governor and governing system in IC engine, Small engines for farm operation, maintenance schedule, troubles, and their remedies. (AAgE0502)

**5.3 Farm machinery:** Farm mechanization scopes, policies and related strategies in Nepal; types, construction and working principle (MB ploughs, Disc ploughs, Harrows, and Rotary tillage tool, chisel plough); tillage implements (requirement, draft power requirement, changing view, testing and selection, and operation and maintenance); Forces acting on primary and secondary tillage implements, Types, construction and working principle (Drills and planters, sprayer, duster, machine for intercultural operation) (AAgE0503)

**5.4 Farm machines and equipment:** Types, construction and working principle (Harvesting machines, threshing machines, and combined harvester, chaff and silage cutter); selection and economics of farm machines and equipment, adjustment and troubleshooting of farm machines and equipment. (AAgE0504)

**5.5 Tractor system and control:** Farm tractor and power tiller (types, different parts, components, range and availability); selection criteria of tractor and power tiller; power transmission system and devices in tractor; operation and maintenance system of tractor and power tiller; expenditure incurred/hour to run the tractor and power tiller; purpose and types of each element of tractor system. (AAgE0505)

**5.6 Machine design:** Engine terminologies used in agricultural machine design; engineering design and design process; selection of material in machine design; factor of safety and basis of safety factor; failure theories and reliability of machine element; analysis of machine elements (Gears, belt drives, clutch and brakes, bearings, shaft, axle, keys, and shaft couplings). (AAgE0506)

## **6. Design of Farm Structures**

**(AAgE06)**

**6.1 RCC structures:** working stress and limit state methods; design of beam and slab; analysis of RC beams and slabs in bending, shear, deflection, bond and end anchorage; design of axially loaded columns isolated and combined footings. (AAgE0601)

**6.2 Farm structure:** Selection, planning, and layout, of farm structure (farmstead, farm residence, water supply and sanitation, farm road, farm fencing, farm ponds and aquaculture ponds, farm irrigation and drainage) (AAgE0602)

**6.3 Design of farm structure:** Types, functional and structural requirement of farm structures (dairy cattle housing, poultry housing, swine housing, goat and sheep housing, fish ponds, feed and forage structures, green house and poly house). (AAgE0603)

**6.4 Elements of farm building:** Elements of farm management; insulating material and their application in farm buildings, requirement of lighting and electricity, water supply and sanitation in residential and farm building, components and selection of electrical farm equipment for farm electrification. (AAgE0604)

**6.5 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)

**6.6 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)

## **7. Crop, Soil, and Watershed Management (AAgE07)**

**7.1 Crop science:** Principle of agronomy and horticultural crops; classification of agronomical and horticultural crops; cropping system, agro climatic requirement and its effect, and cultivation practices of major crops (cereals, grain legumes, oil seed, industrial crop, and tuber crop), major vegetables and spice crops, fruits and plantation crops. (AAgE0701)

**7.2 Soil science:** Classification of soil, soils of Nepal and their suitability for different purposes; physical, chemical, and biological properties of soil. (AAgE0702)

**7.3 Measurement of soil parameter:** Estimation and identification of soil nutrients and their deficiency symptoms; Measurement of soil moisture, pH, electrical conductivity, and organic matter in soil and their importance to maintain the soil productivity; Cultural practices and indigenous knowledge to improve soil fertility of agronomical and horticultural crops. (AAgE0703)

**7.4 Soil conservation:** Concept of soil and water conservation in different ecological regions of Nepal; land use and land capability classifications; Soil loss estimation methods and soil erosion monitoring. (AAgE0704)

**7.5 Water induced disaster:** Causes and mechanisms of landslide, land slip, and debris flow and their control and rehabilitation measures; types of soil erosions and their preventive and control measures (biological and cultural, structural and bioengineering methods). (AAgE0705)

**7.6 Watershed management:** Watershed classification and prioritization; watershed management and planning; methods of soil moisture management; system of water harvesting and recycling; design of farm ponds and conservation ponds; legislation and legal provision in Nepal. (AAgE0706)

## **8. Dairy and Food Engineering (AAgE08)**

**8.1 Refrigeration and cold storage:** Thermodynamic cycles for refrigeration; refrigeration system and types; cold storage (functional requirement, condition for different perishable products, and calculation of cooling load, principle and design of cold storage system); classification of refrigerants and environment friendly refrigerants. (AAgE0801)

**8.2 Bio-materials:** Use of engineering properties of bio material in agricultural processing design; concept, objective, methods, and need of quality control in food industries. (AAgE0802)

**8.3 Post harvesting methods and equipment:** Grain drying needs, methods, and theory; grain pressure theory; types of dryer, performance and energy utilization pattern, seed processing equipment, grain storage structures and importance, moisture content and its determination. (AAgE0803)

**8.4 Post harvesting equipment:** Milling, Hulling, expelling processes and their equipment for rice, wheat, maize, sugarcane, legume, and oilseeds. (AAgE0804)

**8.5 Dairy engineering:** Working principle and unit operation of equipment for receiving, pasteurization, sterilization, homogenization, filling and packaging of dairy product; estimation of refrigeration size requirement in dairy and food products. (AAgE0805)

**8.6 Food engineering:** Economic aspect of food processing, farm crops, animal product, fruits and vegetables; different types of material handling system and devices; and their design consideration. Freezing and freezing equipment, freeze drying, membrane separation and irradiations. (AAgE0806)

## **9. Rural Infrastructure and Energy for Rural Development (AAgE09)**

**9.1 Renewable energy and biomass:** Energy sources and classifications; active and passive use of solar energy in agriculture; design consideration of solar pv and solar thermal technologies (solar air heater, solar water heater, solar cooker, solar crop dryer); energy from biomass (biomass gasification, anaerobic digestion of biomass); bio-diesel production technology. (AAgE0901)

**9.2 Wind and hydroelectric system:** Wind energy and types of converter; micro and small hydroelectric system (planning, installation, operation, and management of rural electric system); energy auditing, application. (AAgE0902)

**9.3 Rural road and bridges:** Concept and approach for green and rural road planning; geometrics in the design of rural roads; structure for cross drainage, slope stabilization and road side retaining structures; Maintenances of earth road, gravel road, water bound macadam; site selection of suspension and suspended bridge; types of culvert. (AAgE0903)

**9.4 Water supply and sanitation:** Sources of water supply and their selection criteria; water demand estimation; WHO guidelines for drinking water quality; different water treatment method; site selection and design criteria for rural water supply system (intake, reservoir and distribution system); design of pit latrine, VIP latrine, pour-flush latrine, septic tank and soak pits; solid waste disposal by landfill and land composting. (AAgE0904)

**9.5 Rural development and agricultural extension:** Concept, importance, problem, and indicator of rural development; basic issues and factor of rural economics; entrepreneurship development, approaches and planning of rural development; project implementation processes and basic elements; agricultural extension delivery system, component and leadership development, types of institution involved in rural development and agricultural extension activities. (AAgE0905)

**9.6 Climate change and adaptation:** Risk, hazard, and vulnerability and its effect on climate; climate change cause, effect, impact, parameter, implication, and adaptation measure in agricultural sector for sustainability; global and national initiatives for climate change. (AAgE0906)

## **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)