

**NCEES Principles and Practice of Engineering Examination
AGRICULTURAL AND BIOLOGICAL ENGINEERING Exam Specifications**

Effective Beginning with the April 2015 Examinations

- The exam is an 8-hour open-book exam. It contains 40 multiple-choice questions in the 4-hour morning session, and 40 multiple-choice questions in the 4-hour afternoon session. Examinee works all questions.
- The exam uses both the International System of units (SI) and the US Customary System (USCS).
- The exam is developed with questions that will require a variety of approaches and methodologies, including design, analysis, and application.
- The knowledge areas specified as examples of kinds of knowledge are not exclusive or exhaustive categories.

**Approximate
Number of Questions
20**

I. Common System Applications

- A. Pump principles (e.g., type, materials, sizing, selection)
- B. Energy balances
- C. Piping systems (e.g., gravity, pressure, components, layout)
- D. Energy sources (e.g., fossil fuels, solar, wind, biomass, hydro)
- E. Engineering economics analysis (e.g., life-cycle costs, budgeting, replacement decisions, benefit-cost, time value of money, fixed and operating costs)
- F. Engineering graphics (e.g., drawings, maps, schematics, nomographs, charts, CAD, GIS)
- G. Environmental assessment techniques (e.g., standards, methods, reporting, sampling)
- H. Health and safety (e.g., operating procedures, manuals, human exposure, operator interface, protective devices)
- I. Statistics application (e.g., experimental design, manufacturing and process control)
- J. Stress-strain relationships (e.g., deflection analysis, material strength, failure analysis)
- K. Process analysis (e.g., efficiency, capacity, performance, durability, cost per ton)
- L. Energy use assessment (e.g., windows, insulation, lighting, latent and sensible heat)
- M. Materials selection (e.g., corrosion resistance, weight, elasticity, cost, strength, machinability, constructability)

- N. Regulated materials handling, storage, and disposal (e.g., facilities, equipment, storage volumes, practices/procedures, codes and standards, containment, permeability of materials, composting, incineration)
- O. Air-quality requirements (e.g., odor, gases, particulate matter, pathogens, emissions inventory)
- P. Codes, regulations, and standards in specific areas of practice (e.g., air quality, water quality, fire protection, EPA, ANSI, ASABE, NIOSH, GMPs, HACCP, IBC, NRCS, NEC)
- Q. Electrical circuits and controls (e.g., determining load, conductor selection, controls, overload protection, grounding, power factor)
- R. Sensors, instrumentation, data loggers, and control circuits and devices (e.g., criteria for selection, application)

II. Natural Resources and Ecology

15

- A. Ecological processes (e.g., interaction of plant/animal/microbial communities, constructed wetlands, stream restoration)
- B. Erosion control and soil stabilization (e.g., risk analysis, conservation practices, basin design)
- C. Hydrology (e.g., precipitation, infiltration, runoff, flood routing, ground water, hydrographs, ET)
- D. Irrigation principles (e.g., application methods/devices, efficiency, uniformity, pipeline design, pumping systems, evapotranspiration, rate, timing)
- E. Nutrient management/loading rates in soils (e.g., budget, CNMP principles, crop nutrient uptake, vegetative treatment areas)
- F. Open-channel hydraulics (e.g., natural and constructed channels, energy dissipation structures, partially filled conduits, weirs and flumes)
- G. Soil-water relationships (e.g., gravimetric water content, volumetric water content, potential)
- H. Surface and subsurface drainage
- I. Engineering surveying principles (e.g., topographic, stakeout, GPS, cuts and fills, interpretation)
- J. Soil mechanics principles (e.g., forces, bearing capacity, shear strength, compaction, slope stability)
- K. Soil physics principles (e.g., infiltration, moisture content, soil physical properties, shrink-swell)
- L. Sediment processes (e.g., detachment, transport, deposition)

III. Process Engineering

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- A. Biological and chemical kinetics (e.g., rates, yields)
- B. Biological transformation (e.g., fermentation, biofiltration, nitrification, denitrification)
- C. Bulk solids characterization (e.g., angle of repose, constitutive relationships, coefficient of friction, density)
- D. Mass transfer between phases (e.g., drying, extraction, leaching, evaporative cooling)

- E. Physical and chemical properties of biological materials (e.g., rheology, thermal properties, electrical properties, optical properties, corrosion, mixability, contamination, compatibility, water activity, D-value)
- F. Physical/chemical separation processes (e.g., filter selection, settling, distillation, ion exchange, decanting, centrifugation)
- G. Reactor vessel design (e.g., types, sizing, mixing, materials)
- H. Fuel characteristics (e.g., energy values, products of combustion, emissions, storage, efficiency)
- I. Applied psychrometric processes (e.g., grain drying, livestock environments, dehydration, crop water use, evaporation)
- J. Mass balances

IV. Facilities

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- A. Animal facilities (e.g., total confinement, pasture, open feedlots, runoff control, layout, animal comfort, space, manure systems, mortality management)
- B. Plant facilities (e.g., environment, space requirements, lighting, nutrients)
- C. Biomaterials processing and storage facilities (e.g., food additives, biofuels, digestion, fermentation, algae growth, grain handling)
- D. Building materials (e.g., strength, corrosion resistance, moisture resistance, durability, concrete mixes, steel, aluminum, lumber, composites)
- E. Foundation design (e.g., soil bearing strength, drainage, loading, reinforcement)
- F. Post-frame building design (e.g., livestock shelters, bulk material storage, packing sheds, warehouses)
- G. Structural analysis (e.g., one- and two-story buildings, bins, silos, retaining walls, waste storage)
- H. Ventilation rate requirements (e.g., heat removal, moisture removal, gas removal)
- I. Ventilation system requirements (e.g., air distribution, fan selection, control strategy, natural and/or mechanical, pressure drop)
- J. Structural specification/codes and standards (e.g., wood, steel, and concrete; dead, live, snow, and wind loads)

V. Machines

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- A. Hydraulic power component performance (e.g., pumps, motors, conduit, pipe size, valves, cylinders, logic controls)
- B. Hydraulic circuit analysis (e.g., heat generation, pressure drop, constant pressure, constant flow, load sensing, unloading, sequencing)
- C. Internal combustion engines (e.g., power curves, specific fuel consumption, power density, combustion cycles, efficiency)
- D. Electric motors (e.g., AC, DC, variable-frequency drives [VFDs], single-phase, three-phase, capacitor start)
- E. Kinematic modeling (e.g., relative position, velocity, acceleration, clearance)

- F. Machine and component power requirements (e.g., electrical, hydraulic, mechanical, pneumatic)
- G. Machines for materials handling/conveyance (e.g., milking, feed handling, waste handling)
- H. Machines for offroad/field use (e.g., harvesters, planters, sprayers, heavy equipment, tillage equipment)
- I. Machines for processes (e.g., mills, grinders, coolers, separators)
- J. Mechanical power transmission (e.g., chains, belts, clutches, gears, shafts, CVT, pulleys, U-joints)
- K. Performance analysis of a machine (e.g., efficiency, throughput, suitability, purity)
- L. Machine stability analysis (e.g., stationary, in-motion or moving)
- M. Structural analysis of machine components (e.g., power transmission systems and drive trains, frames)
- N. Component design (e.g., structural elements, functional elements, fasteners, screw elements, shafts, weld design)
- O. Electronic integration (e.g., measurement and control, remote sensing, circuit components, geospatial guidance systems)