NCEES
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NCEES Principles and Practice of Engineering Examination

AGRICULTURAL AND BIOLOGICAL ENGINEERING CBT Exam Specifications

Effective Beginning October 1, 2023

- The PE Agricultural and Biological Engineering exam is computer-based. It is closed book with electronic references. Standards applicable to the PE Agricultural and Biological Engineering exam are shown on the last page.
- Examinees have 9.5 hours to complete the exam, which contains 85 questions. The 9.5-hour time includes a tutorial and an optional scheduled break. Examinees work all questions.
- The exam uses both the International System of Units (SI) and the U.S. 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 within each exam topic are not exclusive or exhaustive categories.

	Number of Questions
1. Common System Applications	**19–29**

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

O. Materials handling, storage, and disposal (e.g., facilities, equipment, storage volumes, practices/procedures, codes and standards, containment, permeability of materials, composting, incineration, landfill)
P. Codes, regulations, and standards in specific areas of practice (e.g., air quality, water quality, fire protection, EPA, ANSI, ASABE, NIOSH, FSMA, IBC, NRCS, NEC, FEMA)
Q. Electrical circuits and controls (e.g., determining load, conductor selection, controls, overload/fault protection, grounding, power factor)
R. Sensors, instrumentation, data loggers, control circuits, communication systems, and devices (e.g., criteria for selection, application)
S. Project management (e.g., scheduling, labor, materials, resources, estimation, critical path)
T. Electric motors (e.g., ac, dc, variable frequency drives [VFDs], single-phase, three-phase, capacitor start, frame and enclosure types)
U. Engineering surveying principles (e.g., topographic, stakeout, GPS, cuts and fills, interpretation)

2. Natural Resources and Environmental Systems **15–23**

A. Environmental systems analysis (e.g., interaction of plant/animal/microbial communities, constructed wetlands, stream restoration, floodplain, nitrification rate, chemical balance, water-holding capacity, oxidation/reduction, aerobic/anaerobic, loading N&P, pH)
B. Erosion control, soil stabilization, and sedimentation (e.g., risk analysis, conservation practices, basin design, universal soil loss equation [USLE], sediment loading, vegetative filter strip [VFS], Stokes' law, detachment, transport, deposition, turbidity)
C. Hydrology (e.g., precipitation, infiltration, runoff, flood routing, groundwater, hydrographs, time of concentration, evapotranspiration, runoff curve number)
D. Irrigation principles (e.g., application methods/devices, efficiency, uniformity, pipeline design, pumping systems, evapotranspiration, rate, scheduling, consumptive use, managed allowable deficit [MAD])
E. Nutrient management/loading rates in soils (e.g., budget, comprehensive nutrient management plan [CNMP] principles, crop nutrient uptake, vegetative treatment areas, allowable levels, hot spots)
F. Open-channel hydraulics (e.g., natural and constructed channels, culverts, energy dissipation structures, partially filled conduits, weirs and flumes)
G. Soil and water (e.g., soil mechanics, soil physics, gravimetric water content, volumetric water content, potential, bearing capacity, shear strength, compaction, slope stability, infiltration, moisture content, soil physical properties, shrink-swell)
H. Surface and subsurface drainage (e.g., ditches, tile drainage, controlled drainage, pumped drainage)

I. Stormwater management (e.g., design of retention ponds, calculating trapping efficiencies, combined permeability of layers, design of grass waterways, swale design, reducing peak flows)
J. Computer modeling (e.g., hydrologic and hydraulic simulation, evapotranspiration, delineating watersheds, time to peak flow for a basin)
K. Environmental policy (e.g., TMDLs, NPDES permits, water rights, threatened and endangered species, wetland delineation, regulations)
L. Dams and reservoirs (e.g., sizing reservoirs, freeboard, design storm, dam height, spillways, side slopes)

3. Processing Systems **12–18**

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, coefficient of friction, density)
D. Mass transfer (e.g., drying, extraction, leaching, evaporative cooling, cooking)
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. Applied psychrometric processes (e.g., drying, dehydration, crop water use, evaporation)
G. Physical and chemical properties of water in all phases (e.g., enthalpy, latent heat of vaporization, latent heat of fusion)
H. Process heating and cooling (e.g., heat transfer, pasteurization, coolers)
I. Food safety and quality control (e.g., quality control point [QCP], critical control point [CCP], allergen control, good manufacturing practice [GMP], hazard analysis and risk-based preventive controls [HARPC], pathogen control, pest control, condensation control)

4. Facilities and Structures **12–18**

A. Animal facilities (e.g., environment, total confinement, pasture, open feedlots, runoff control, layout, animal welfare, space, manure systems, mortality management)
B. Plant production facilities (e.g., greenhouses, environment, space requirements, lighting, nutrients)
C. Food and biomaterials processing and storage facilities (e.g., sanitary design, layout, drainage, material movement, allergen control, hygienic zones, food additives, biofuels, fermentation, grain handling)
D. Building materials (e.g., strength, corrosion resistance, moisture resistance, pest management, durability, concrete mixes, steel, aluminum, lumber, composites, cost)
E. Foundation design (e.g., soil bearing strength, footing, frost level, drainage, loading, reinforcement, floating pads, soil physics)

F. Post-frame building design (e.g., livestock shelters, bulk material storage, packing sheds, warehouses, post footing, diaphragms)
G. Structural analysis (e.g., one- and two-story buildings, bins, silos, tanks, retaining walls, waste storage, wood structures)
H. Ventilation rate requirements (e.g., heat removal, moisture removal, gas removal, odor 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, concrete; dead, live, snow, and wind loads)

5. Machinery Systems **12–18**

A. Hydraulic power component performance (e.g., pumps, motors, 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. Machine and component power requirements (e.g., electrical, hydraulic, mechanical, pneumatic)
E. Machines for materials handling/conveyance/processing (e.g., milking, feed handling, waste handling, grain elevator, size reduction)
F. Machines for off-road/field use (e.g., harvesters, planters, sprayers, heavy equipment, tillage equipment)
G. Mechanical power transmission (e.g., chains, belts, clutches, gears, shafts, CVT, pulleys, U-joints)
H. Performance analysis of a machine (e.g., efficiency, throughput, suitability, purity, stability, vibration)
I. Structural analysis of machine components (e.g., power transmission systems and drive trains, frames, fatigue failure)
J. Component design (e.g., structural elements, functional elements, fasteners, screw elements, shafts, weld design, rollover protective structure)

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PE AGRICULTURAL AND BIOLOGICAL ENGINEERING Standards
Effective with Exams Beginning October 1, 2023

ASABE standards will be supplied to examinees on exam day as searchable pdf files in the exam if they are required to answer an exam question. The collection is available on ASABE.org. Examinees are not allowed to bring any reference material into the exam room.

Solutions to exam questions that reference a standard of practice are scored based on this list and the revision year shown. Solutions based on other standards will not receive credit.

ANSI/ASABE AD11684:1995 APR 2011 (R2021)	Tractors, machinery for agricultural and forestry, powered lawn and garden equipment—Safety signs and hazard pictorials—General principles
ANSI/ASAE D241.4 OCT 1992 (R2017ED)	Density, Specific Gravity, and Mass-Moisture Relationships of Grain for Storage
ASAE D243.4 MAY 2003 (R2017)	Thermal Properties of Grain and Grain Products
ASAE D245.6 OCT 2007 (R2017ED)	Moisture Relationships of Plant-based Agricultural Products
ASAE D271.2 APR 1979 (R2014)	Psychrometric Data
ASAE D272.3 MAR 1996 (R2016)	Resistance to Airflow of Grains, Seeds, Other Agricultural Products, and Perforated Metal Sheets
ASAE D274.1 JAN 1992 (R2017)	Flow of Grain and Seeds Through Orifices
ASAE D384.2 MAR 2005 (R2019)	Manure Production and Characteristics
ASAE EP260.5 FEB 2015 (R2019)	Design and Construction of Subsurface Drainage Systems on Agricultural Lands in Humid Areas
ASAE EP270.5 DEC 1986 (R2017)	Design of Ventilation Systems for Poultry and Livestock Shelters
ASAE EP285.8 FEB 2014 (R2018)	Use of SI (Metric) Units

ANSI/ASAE EP302.4 FEB 1993 (R2017)	Design and Construction of Surface Drainage Systems on Agricultural Lands in Humid Areas
ASAE EP369.1 DEC 1987 (R2019)	Design of Agricultural Drainage Pumping Plants
ASAE EP379.5 APR 2012 (R2016)	Management of Manure Odors
ASAE EP393.3 DEC 1998 (R2018)	Manure Storages
ANSI/ASAE EP403.4 FEB 2011 (R2020)	Design of Anaerobic Lagoons for Animal Waste Management
ASAE EP405.1 APR 1988 (R2019)	Design and Installation of Microirrigation Systems
ASAE EP413.2 FEB 2010 (R2019)	Procedure for Establishing Volumetric Capacities of Cylindrical Grain Bins
ASAE EP463.2 NOV 2009 (R2019)	Design, Construction, and Maintenance of Subsurface Drains in Arid and Semiarid Areas
ASABE EP 464.1 FEB 2016	Grassed Waterway for Runoff Control
ASAE EP473.2 JAN 2001 (R2020)	Equipotential Plane in Livestock Containment Areas
ASAE EP479.1 DEC 2013 (R2018)	Operation of Controlled Drainage Systems in Humid Regions
ANSI/ASAE EP484.3 DEC 2017	Diaphragm Design of Metal-Clad, Wood-Frame Rectangular Buildings
ANSI/ASAE EP486.3 SEP 2017	Shallow Post and Pier Foundation Design
ASAE EP496.3 FEB 2006 (R2020)	Agricultural Machinery Management
ASAE EP542.1 NOV 2019	Procedures for Using and Reporting Data Obtained with the Soil Cone Penetrometer
ANSI/ASAE EP545 MAR 1995 (R2019)	Loads Exerted by Free-Flowing Grain on Shallow Storage Structures
ASABE/ISO 15077:2008 OCT 2008 (R2018)	Tractors and self-propelled machinery for agriculture—Operator controls — Actuating forces, displacement, location and method of operation

ASAE S268.6 MAR 2017	Terrace Systems
ANSI/ASAE S279.18 OCT 2019	Lighting and Marking of Agricultural Equipment on Highways
ANSI/ASAE S358.3 MAY 2012 (R2017)	Moisture Measurement—Forages
ANSI/ASAE S376.3 FEB 2016 (R2020)	Design, Installation and Performance of Underground, Thermoplastic Irrigation Pipelines
ANSI/ASAE S433.1 JAN 2019	Loads Exerted by Free-Flowing Grain on Bins
ASAE S442.2 FEB 2017	Water and Sediment Control Basins
ASAE S501 APR 1990 (R2020ED)	Uniform Terminology for Livestock Production Facilities
ASAE S526.4 SEP 2015 (R2019)	Soil and Water Terminology