

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

Effective Beginning October 1, 2021

- **The exam topics have not changed since April 2015 when they were originally published.**
- 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. 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.

	Number of Questions
1. Common System Applications	18–27
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)

2. Natural Resources and Ecology

13–19

- 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)

3. Process Engineering

13–19

- 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

4. Facilities

13–19

- 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)

5. Machines

13–19

- 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)

**NCEES Principles and Practice of Engineering Examination
PE AGRICULTURAL AND BIOLOGICAL ENGINEERING Standards**

Effective with Exams Beginning October 1, 2021

Revisions shown in red and posted April 1, 2021

The standards in the "ASABE Standards Reference Collection for the PE Exam" will be supplied to examinees on exam day as an electronic pdf file in the exam if they are required to answer an exam question. The collection is available on ASABE.org. You 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