NCEES
advancing licensure for engineers and surveyors

NCEES Principles and Practice of Engineering Examination
CONTROL SYSTEMS Exam Specifications

Effective Beginning April 2027

- The exam is computer-based. It is closed book with an electronic reference. Design standards applicable to the PE Control Systems 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 specified as examples of kinds of knowledge are not exclusive or exhaustive categories.

	Number of Questions
1. Measurement	**16–24**

A. Sensor technologies applicable to general measurement (e.g., flow, pressure, level, temperature, counters, motion) including principles, specification, selection, and cost considerations
B. Sensor technologies applicable to general analytical instruments and sampling systems (e.g., pH, ORP, density, O2, conductivity, effects of sampling systems, moisture) including principles, specification, selection, and cost considerations
C. Sensor technologies applicable to fire and gas detectors (e.g., cameras, IR, UV, open path) including principles, specification, selection, and cost considerations
D. Sensor technologies applicable to machinery monitoring and protection (e.g., vibration, temperatures, pressures, thrust, speed) including principles, specification, selection, and cost considerations
E. Sensor characteristics (e.g., rangeability, accuracy and precision, temperature effects, response times, reliability, repeatability, calibration, hysteresis, drift)
F. Sensor selection and material compatibility (e.g., plugging service, process severity, environmental effects and constraints, and cost considerations)
G. Sensor installation details and drawings (e.g., process, pneumatic, electrical, location, maintenance, calibration, block/root valve selection, position/geometry/accessibility, startup, reliability, failure mode, constructability)
H. Flow calculations (e.g., element sizing, pressure-temperature compensation, mass/volume conversions, pressure drop, velocity, Reynolds number, beta ratio)
I. Level calculations (e.g., pressure and differential pressure, level, density, elevation/suppression, composition, P-T compensation)
J. Process measurement unit conversion calculations (e.g., standard volumetric flow to mass flow or to actual flow, height to volume in cylindrical or sphere)

K. Thermowell design parameters and impact (e.g., type, dimensions, velocity, density, natural frequency, wake frequency)
L. Sensor testing and commissioning (e.g. loop test, calibration, square root extraction, range verification, simulation of values, diagnostics)

2. Control Systems **17–26**

A. Engineering drawings, diagrams, symbology, and terminology (e.g., P&ID, process flow diagrams, control loop diagrams, logic diagrams, cause and effect diagrams, schematics)
B. Control theory including process dynamics and response for analog, discrete, and sequential control methods for common processes and components (e.g., pumps, compression, combustion, evaporation, distillation, hydraulics, reaction, dehydration, heat exchangers, crystallization, filtration, refrigeration, fluidization)
C. Human factors including displays, alarm management, and equipment layout (e.g., HMI, control room, panel, alarm KPIs, and console layouts)
D. Logic implementation, configuration/programming, logic exception handling, and diagnosis of unexpected behavior, including interpretation of logic types (e.g., ladder diagrams, function blocks, sequential function charts, and structured text),
E. System design (architecture, hardware, interfaces, and security) to meet requirements, limitations, and costs, including capacity, availability, heat load, power consumption, and environmental constraints
F. System testing, commissioning, and performance monitoring (e.g., factory acceptance test, integrated system test, site acceptance test, system diagnostics, and management of change)
G. Control systems cybersecurity and security practices (e.g., management systems, risk assessments, security-level verification, management of change, monitoring, protections)

3. Final Control Elements **14–21**

A. Valve type and material selection based on application and process characteristics (e.g., erosion, corrosion, pressure, temperature, material compatibility, environmental)
B. Valve trim selection (e.g., seat leakage class, noise reduction, characteristics)
C. Valve calculations (e.g., sizing, pressure drop, split range)
D. Valve actuator type application and selection including failure modes
E. Impacts of fluid dynamics (e.g., cavitation, flashing, choked flow, Joule-Thompson effects, two-phase, noise)
F. Valve accessories (e.g., limit switches, solenoid valves, positioners, transducers, air regulators, boosters, quick exhaust)
G. Valve installation practices (e.g., vertical, horizontal, bypasses, location, flow direction)
H. Pressure relieving device types, material selection, and installation (e.g., conventional spring, balanced bellows, pilot-operated, rupture disk, buckling pin)
I. Pressure relieving device calculations (e.g., sizing considering inlet pressure drop, back pressure, and multiple valves)
J. Motor control types and applications (e.g., motor starters, variable/adjustable speed drives, soft starters, reading schematics)

K. Motor control accessories (e.g., encoders, positioners, relays, limit switches)
L. Solenoid valves as final elements – types, application, and selection
M. Relay types, application, and selection (e.g., energize and de-energize to trip, NO/NC contacts)
N. Self-regulating device types, application, and selection (e.g., sizing, pressure, temperature, level, and flow regulators)
O. Final element testing and commissioning (e.g. loop test, calibration, range verification, simulation of values, diagnostics)

4. Signals, Transmission, and Networking **11–17**

A. Signal types and technologies (e.g., analog, discrete, buses, topologies, limitations, protocols)
B. Signal conversion principles (e.g., analog/digital [A/D], digital/analog [D/A], current/pneumatic [I/P], current/current [I/I], splitters, filters, bit precision, signal error)
C. Hazardous area classifications and installation techniques (e.g., intrinsically safe (IS) barriers, cabinet purges, non-incendive, transient protection, explosion-proof)
D. Power, grounding, electrical segregation, electromagnetic interference (e.g., UPS, fusing, diode protection, calculations of voltage drops, control signal isolation)
E. Signal circuit design and calculations (e.g., two-wire, four-wire, isolated outputs, loop powered, buses, voltage, current, impedance, power)
F. Communications systems architecture and protocols (e.g., fiber optics, coaxial cable, wireless, paired conductors, buses, Transmission Control Protocol/Internet Protocol [TCP/IP], OPC, network addressing)

5. Safety Instrumented Systems **12–18**

A. Functional safety life cycle structure and phases (e.g., deliverables, requirements, purpose, and timing)
B. Hazard and risk assessment. Allocation of safety functions to protection layers (e.g., safety layer matrix, risk graph, LOPA, QRA, IPL requirements, identification of SIFs, purpose, and outcomes)
C. Safety requirements specifications (SRS) (e.g., documentation and requirements)
D. Design and engineering of safety instrumented systems (e.g., device selection, SIL calculation formulas and variables, design constraints, and FAT)
E. Installation, commissioning, and validation including procedures and site acceptance testing (SAT)
F. Operation and maintenance (e.g., inspection, testing, demands, failures and failure rates, causes, bypass management, and degradation)
G. Modification and decommissioning/management of change

NCEES
advancing licensure for
engineers and surveyors

NCEES Principles and Practice of Engineering Examination
CONTROL SYSTEMS Design Standards

Effective Beginning April 2027

In addition to the *PE Control Systems Reference Handbook*, the following codes and standards will be supplied in the exam as searchable, electronic pdf files with links for easy navigation.

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.

NCEES does not sell design standards or printed copies of the NCEES handbook. The NCEES handbook is accessible from your MyNCEES account. Design standards are available through the publisher or a bookseller.

ABBREVIATION	DESIGN STANDARD TITLE
ANSI/ISA-5.1	*Instrumentation and Control – Symbols and Identification*, 2024, International Society of Automation, Research Triangle Park, NC, www.isa.org.
ANSI/ISA/IEC 61511	*Functional Safety – Safety Instrumented Systems for the Process Industry Sector, Part 1: Framework, definitions, system, hardware and application programming requirements*, 2018, International Society of Automation, Research Triangle Park, NC, www.isa.org.