NCEES Principles and Practice of Engineering Examination

INDUSTRIAL AND SYSTEMS CBT Exam Specifications

Effective beginning with the October 2020 Examinations

- The PE Industrial and Systems exam is computer-based. It is closed book with an electronic reference.
- 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 U.S. Customary System (USCS).
- The exam is developed with questions that will require a variety of approaches and methodolgies, including design, analysis, and application. Some questions may require knowledge of engineering economics, probability and statistics, operations research techniques, engineering management systems, project management, and codes and standards (e.g., ISO, OSHA, MIL STD, and NIOSH).
- The knowledge areas specified as examples of kinds of knowledge are not exclusive or exhaustive categories.
- The **standards** applicable to the Industrial and Systems exam are shown on the last page.

	Number of Questions
1. Systems Engineering	**14–21**

A. System analysis and design tools (e.g., flowcharts, Pareto charts, affinity diagrams, nominal group technique, input/output analysis, value stream mapping)
B. Requirements analysis (e.g., Quality Function Deployment, functional requirements, constraints)
C. Performance measures and applications (e.g., cost, environmental sustainability, output)
D. Modeling techniques (e.g., simulation, queuing, linear programming, graph theory and networks, Markov chains)
E. Process types (e.g., discrete versus continuous, manufacturing, service)
F. Model assessment (e.g., interpretation, verification, validation, sensitivity analysis)
G. Bottleneck analysis (e.g., theory of constraints)
H. Value analysis and engineering
I. Project management and planning (e.g., PERT/CPM/CCPM: risk analysis, cost, scope, and time; Gantt charts)

2. Facilities Engineering and Planning **14–21**

A. Process flow
B. Layout design techniques (e.g., systematic layout planning [SLP], affinity diagram, relationship diagrams, center of gravity rule)
C. Space analysis (e.g., equipment needs, demand, location, footprint of the equipment/WIP sizing, warehousing)
D. Capacity analysis (e.g., calculation of personnel requirements, calculation of machine requirements)
E. Cost-benefit analysis
F. Site selection factors and methods (e.g., prioritization, factor weighting, network optimization)
G. Unit load analysis
H. Facility life cycle cost analysis (e.g., acquisition, implementation, sustainment, retirement)
I. Material handling techniques and equipment (e.g., conveyors, industrial trucks, manual, overhead crane)

3. Operations Engineering **14–21**

A. Forecasting methods (e.g., time series, causal models, qualitative techniques)
B. Production planning methods (e.g., capacity planning, materials planning, JIT, lot sizing, workforce planning, aggregate planning)
C. Engineering economics (e.g., break-even analysis, technical capability assessment, ROR)
D. Costing systems (e.g., activity-based costing including cost drivers, guidelines for overhead, labor, materials)
E. Production scheduling methods (e.g., shortest processing time first, due date order)
F. Inventory management and control policies (e.g., deterministic, stochastic)
G. Distribution models (e.g., transshipment, direct ship, cross docking, intermediate storage)
H. Storage and warehousing methods
I. Transportation modes (e.g., truckload [TL], less than truckload [LTL], air, rail, ship)

4. Work Design **14–21**

A. Methods for analysis and improvement (e.g., therbligs, motion study, man-machine charts)
B. Line balancing
C. Work measurement systems techniques (e.g., stopwatch, predetermined time systems, proprietary process determined time system)
D. Learning curves
E. Sample size calculations
F. Work sampling analysis
G. Safety codes, standards, and voluntary guidelines (e.g., ANSI, OSHA, MIL STD, NIOSH)

H. Methods for quantifying risk factors (e.g., NIOSH lifting equation, OSHA limits for noise, coefficient of friction, RULA)
I. Limits of human capacity (e.g., strength, endurance, metabolic energy, range of motion, vision, hearing, skeletal-joint force analysis, exposure)
J. Lifting aids (e.g., hoist, cranes, lifting tables)
K. Link analysis and associated criteria (e.g., importance, frequency of use)
L. Workplace design/human–computer interaction (e.g., use of anthropometric data)
M. Days Away, Restricted and Transferred (DART) rate calculations (e.g., injury/illness incident rate and/or management of information required to calculate this rate)
N. Manufacturing/service process planning (e.g., selection of operations, sequence, instructions, tooling and fixturing, mistake proofing)

5. Quality Engineering **14–21**

A. Statistical process control (e.g., control chart construction and interpretation)
B. Process capability analysis (e.g., Cpk, Cp)
C. Acceptance sampling (e.g., single sampling, double sampling, MIL STD 105E, Dodge Romig, OC-curves)
D. Quality systems (e.g., Deming, TQM, ISO 9000, benchmarking)
E. Techniques for process improvement (e.g., design of experiments [DOE], Taguchi, FMEA)
F. Reliability analysis
G. Maintenance procedures (e.g., reactive, preventive, predictive)
H. Root cause analysis

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INDUSTRIAL AND SYSTEMS Standards

Effective Beginning with the October 2020 Exam

The following standards will be supplied to examinees on exam day as an electronic pdf file in the exam. Solutions to exam questions that reference a standard of practice are scored based on this list. Solutions based on other standards will not receive credit.

STANDARD	TITLE
MIL-STD-105E	Sampling Procedures and Tables for Inspection by Attributes
MTM-1	Normal Time Values for MTM-1 Motion Element