Engineering Fundamentals Exam

Industrial Engineering Standards

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Introduction

Engineering standards are the set of knowledge, abilities, and professional attributes necessary to practice the engineering profession [3-5]. Every Engineering Standard is linked to a number of indicators. These indicators can be viewed as instruments that measure the examinee fulfillment of the corresponding standard. In other words, a Standard is a broad statement about a specific topic, whereas, the Indicators are specific requirements extracted from the Standard and directly linked to the exam question.

Some of these first level standards are drawn from the completion of a Bachelor of Engineering degree from an accredited engineering college. An accredited engineering degree program usually has the breadth of understanding of a wide range of technologies and applications. It also usually has sufficient depth in at least one specific area of practice to develop competence in handling technically complex problems [6].

The knowledge part of the first level standards include, generally, knowledge of science and engineering fundamentals, in-depth technical competence in an engineering discipline, knowledge of theoretical and experimental techniques, knowledge of basic business and project management practices, and broad general knowledge.

The ability part of the first level standards include, generally, the ability to identify, formulate, and solve problems, ability to understand environmental and social issues, ability to deal with ambiguity and complex problems, ability to perform engineering design, and an ability to interpret and visualize data [3-5].

The professional Attributes part of the first level standards are the sets of skills often sought by employers for hiring engineers either fresh graduates or experienced. They are sometimes called “soft” or “general” skills. They include capacity for effective communication [7] with the engineering team and costumers, capacity for effective work within multidisciplinary and multicultural teams, capacity for lifelong learning and professional development, self-drive and motivation, creativity and innovation, leadership, and capacity to maintain a professional image in all circumstances [3-5].

Industrial Engineering Standards

The Engineering Standards for the Industrial Engineering Discipline are structured around eight core topics:

1. Engineering Economics
2. Probability and Statistics
3. Modeling and Computation
4. Industrial Management
5. Manufacturing and Production Systems
6. Facilities and Logistics
7. Human Factors, Productivity, Ergonomics, and Work Design
8. Quality Engineering

Each Indicator is projected onto three Learning Levels (obtained by combining every two consecutive levels in the revised Bloom's taxonomy into one level)

1. Remembering and Understanding
2. Applying and Analyzing
3. Evaluating and Creating

Standards are coded IE-TJ where:

- IE denotes Industrial Engineering
- TJ denotes Topic Number J

Indicators are coded IE-TJ-K (where K denotes the Indicator number).

Example

Topic: **T1:** Engineering Economics

Standard: **IE-T1**: Industrial engineers should possess the ability to apply engineering economics fundamentals to perform cost analysis and estimation, and support decision making.

Indicator: **IE-T1-05**: Utilize engineering Economics analysis in decision making (budgeting, replacement, risk, and uncertainty).

Learning Level: Applying and Analyzing (AA)

T1: Engineering Economics (14%)

IE-T1 Industrial engineers should possess the ability to apply engineering economics fundamentals to perform cost analysis and estimation, and support decision making. The following Indicators are addressed in the *Test Questions* on this *Topic Area*:

T1-Indicators

IE-T1-01 Recognize and demonstrate use of fundamentals of engineering economics (role in decision making, interest rate, rate of return, cash flows, cost types, compounding factors)

IE-T1-02 Apply fundamentals of engineering economics (cost types, cost analysis, worth analysis, cost accounting, taxes, depreciation, inflation)

IE-T1-03 Utilize tools of worth analysis and discounted cash flows (present worth, future worth, capitalized cost analysis, annual worth)

IE-T1-04 Evaluate alternatives (replacement and retention, payback, breakeven analysis)

IE-T1-05 Utilize engineering economics analysis in decision making (budgeting, taxes, depreciation, inflation, risk and uncertainty)

T2: Probability and Statistics (14%)

IE-T2 Industrial engineers should possess the ability to utilize probability and statistics fundamentals and tools to represent data, test hypothesis, and design experiments. The following Indicators are addressed in the *Test Questions* on this *Topic Area*:

T2-Indicators

IE-T2-01 Recognize and utilize probability theory and probability distributions of random variables (continuous, discrete)

IE-T2-02 Apply principles and tools of statistics (descriptive statistics, estimation, confidence intervals, sampling and sample sizes)

IE-T2-03 Utilize tools of statistical analysis (hypothesis testing, analysis of variance, regression and correlation, discrete variables, continuous variables)

IE-T2-04 Apply rules of hypothesis testing (parametric and nonparametric variables)

IE-T2-05 Apply rules of regression analysis (linear and multiple)

IE-T2-06 Demonstrate use of factorial designs and apply fundamentals of design of experiments (ANOVA, 2^k, block design)

T3: Modeling and Computation (14%)

IE-T3 Industrial engineers should possess the ability to model industrial systems, determine, predict and monitor their performance parameters. The following Indicators are addressed in the *Test Questions* on this *Topic Area*:

T3-Indicators

IE-T3-01 Apply the concepts of mathematical programming and optimization (linear programing, integer, Deterministic Dynamic Programming, transportation)

IE-T3-02 Use the principles and elementary constructs of systems models including discrete-time and state system theories, and life-cycle performance

IE-T3-03 Use concepts of mathematical programming and optimization (decision variables, objective functions, constraints, sensitivity analysis)

IE-T3-04 Apply the principles of Minimum Spanning Tree (MST), Shortest Path (SP) and Maximum Flow Minimum Cut Problems (MFMCP)

IE-T3-05 Utilize stochastic models (queuing, Markov, simulation)

IE-T3-06 Use IT techniques to gather, record, analyze and present the data

IE-T3-07 Test and validate models using simulation techniques

T4: Industrial Management (10%)

IE-T4 Industrial engineers should possess the ability of applying engineering management principles to engineering projects. The following Indicators are addressed in the *Test Questions* on this *Topic Area*:

T4-Indicators

IE-T4-01 Define the principles of production management systems (planning, organizing, and controlling of production systems)

IE-T4-02 Utilize project management techniques (scheduling, CPM, PERT, crashing, time control, cost control and organization)

IE-T4-03 Plan job evaluation and compensation strategies

T5: Manufacturing and Production Systems (14%)

IE-T5 Industrial engineers should possess the ability to apply production planning and control to improve industrial systems' performance. Industrial engineers should also be able to apply modern manufacturing systems techniques in automation and material handling for better performance. The following Indicators are addressed in the *Test Questions* on this *Topic Area*:

T5-Indicators

IE-T5-01 Recognize engineering materials properties, fundamentals of engineering materials and processing parameters

IE-T5-02 Recognize characteristics of integrated manufacturing systems (material handling, production lines, manual assembly lines, automated, flexible, cellular, lean, CIM)

IE-T5-03 Recognize automation fundamentals

IE-T5-04 Utilize production planning and control techniques (forecasting, scheduling, aggregate planning, MRP, JIT, MRPII, ERP and inventory control)

IE-T5-05 Utilize automation technology (CNCs, industrial robotics and CIM)

IE-T5-06 Apply principles of manufacturing support systems (process planning, concurrent engineering and design for manufacturability)

IE-T5-07 Design production systems (equipment selection, labor selection, training, methods and production line balancing)

T6: Facilities and Logistics (12%)

IE-T6 Industrial engineers should possess the ability to design and locate industrial facilities. Industrial engineers should also possess the ability to design supply chain and logistics systems. The following Indicators are addressed in the *Test Questions* on this *Topic Area*:

T6-Indicators

IE-T6-01 Recognize facility location factors and types of plant layout

IE-T6-02 Utilize computer aided layout design techniques

IE-T6-03 Analyze facility location and layout (single, multiple, storage, distance metrics)

IE-T6-04 Design automated handling and storage systems

IE-T6-05 Design supply chain

IE-T6-06 Evaluate alternate locations

T7: Human Factors, Productivity, Ergonomics, and Work Design (12%)

IE-T7 Industrial engineers should possess the ability to utilize work design and human factors theory, principles and data in order to optimize human well-being and overall system performance. The following Indicators are addressed in the *Test Questions* on this *Topic Area*:

T7-Indicators

IE-T7-01 Identify occupational hazards and risk factors (MSD, toxicology, fire)

IE-T7-02 Utilize basic work measurement techniques for task analysis and evaluation (methods engineering, charting, motion analysis, time study, work sampling, MTM, MOST, standard data systems)

IE-T7-03 Design workplace (tasks, layouts, displays, controls, interfaces, workload)

IE-T7-04 Design workplace environment (lighting, noise, temperature, noise)

IE-T7-05 Evaluate physical and mental workload and plan work/rest schedules

IE-T7-06 Utilize ergonomics assessment techniques to evaluate workplace risk factors (checklists, questionnaires, anthropometry, biomechanical models)

T8: Quality Engineering (10%)

IE-T8 Industrial engineers should possess the ability to observe quality and recognize its concepts. Industrial engineers should be able to utilize quality tools and principles to effectively monitor and improve systems' quality. The following Indicators are addressed in the *Test Questions* on this *Topic Area*:

T8-Indicators

IE-T8-01 Define the basic concepts of quality, TQC, TQM, DOE, process capability, overall quality program management and implementation

IE-T8-02 Recognize quality costs and their relevant quality improvement strategies

IE-T8-03 Use quality improvement techniques (Pareto diagram, matrix analysis, check sheets, etc.)

IE-T8-04 Apply principles of statistical quality control (control charts, process capability)

IE-T8-05 Apply fundamentals of analytical tools (fault trees, cause and effect)

IE-T8-06 Apply six sigma

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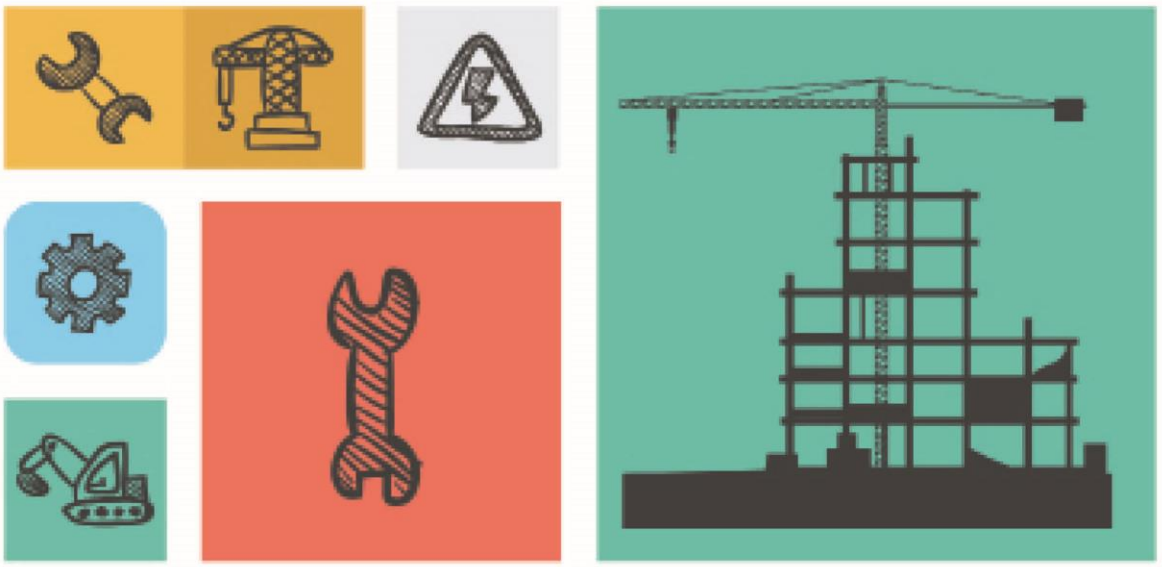

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