NCEES
advancing licensure for
engineers and surveyors

Fundamentals of Engineering (FE)
OTHER DISCIPLINES CBT Exam Specifications
Effective Beginning with the January 2014 Examinations

- The FE exam is a computer-based test (CBT). It is closed book with an electronic reference.

- Examinees have 6 hours to complete the exam, which contains 110 questions. The 6-hour time also includes a tutorial and an optional scheduled break.

- The FE exam uses both the International System of Units (SI) and the US Customary System (USCS).

Knowledge   **Number of Questions**

1. **Mathematics and Advanced Engineering Mathematics**   **12–18**
   A. Analytic geometry and trigonometry
   B. Calculus
   C. Differential equations (e.g., homogeneous, nonhomogeneous, Laplace transforms)
   D. Numerical methods (e.g., algebraic equations, roots of equations, approximations, precision limits)
   E. Linear algebra (e.g., matrix operations)

2. **Probability and Statistics**   **6–9**
   A. Measures of central tendencies and dispersions (e.g., mean, mode, variance, standard deviation)
   B. Probability distributions (e.g., discrete, continuous, normal, binomial)
   C. Estimation (e.g., point, confidence intervals)
   D. Expected value (weighted average) in decision making
   E. Sample distributions and sizes
   F. Goodness of fit (e.g., correlation coefficient, least squares)

3. **Chemistry**   **7–11**
   A. Periodic table (e.g., nomenclature, metals and nonmetals, atomic structure of matter)
   B. Oxidation and reduction
   C. Acids and bases
   D. Equations (e.g., stoichiometry, equilibrium)
   E. Gas laws (e.g., Boyle's and Charles' Laws, molar volume)

4. **Instrumentation and Data Acquisition**   **4–6**
   A. Sensors (e.g., temperature, pressure, motion, pH, chemical constituents)
   B. Data acquisition (e.g., logging, sampling rate, sampling range, filtering, amplification, signal interface)
   C. Data processing (e.g., flow charts, loops, branches)

5. **Ethics and Professional Practice**   **3–5**
   A. Codes of ethics
   B. NCEES *Model Law* and *Model Rules*
   C. Public protection issues (e.g., licensing boards)

6. Safety, Health, and Environment 4–6
   A. Industrial hygiene (e.g., carcinogens, toxicology, MSDS, lower exposure limits)
   B. Basic safety equipment (e.g., pressure relief valves, emergency shut-offs, fire prevention and control, personal protective equipment)
   C. Gas detection and monitoring (e.g., O_2, CO, CO_2, CH_4, H_2S, Radon)
   D. Electrical safety

7. Engineering Economics 7–11
   A. Time value of money (e.g., present worth, annual worth, future worth, rate of return)
   B. Cost (e.g., incremental, average, sunk, estimating)
   C. Economic analyses (e.g., breakeven, benefit-cost, optimal economic life)
   D. Uncertainty (e.g., expected value and risk)
   E. Project selection (e.g., comparison of unequal life projects, lease/buy/make, depreciation, discounted cash flow)

8. Statics 8–12
   A. Resultants of force systems and vector analysis
   B. Concurrent force systems
   C. Force couple systems
   D. Equilibrium of rigid bodies
   E. Frames and trusses
   F. Area properties (e.g., centroids, moments of inertia, radius of gyration)
   G. Static friction

9. Dynamics 7–11
   A. Kinematics
   B. Linear motion (e.g., force, mass, acceleration)
   C. Angular motion (e.g., torque, inertia, acceleration)
   D. Mass moment of inertia
   E. Impulse and momentum (linear and angular)
   F. Work, energy, and power
   G. Dynamic friction
   H. Vibrations

10. Strength of Materials 8–12
   A. Stress types (e.g., normal, shear, bending, torsion)
   B. Combined stresses
   C. Stress and strain caused by axial loads, bending loads, torsion, or shear
   D. Shear and moment diagrams
   E. Analysis of beams, trusses, frames, and columns
   F. Deflection and deformations (e.g., axial, bending, torsion)
   G. Elastic and plastic deformation
   H. Failure theory and analysis (e.g., static/dynamic, creep, fatigue, fracture, buckling)

11. **Materials Science**   **6–9**
    A. Physical, mechanical, chemical, and electrical properties of ferrous metals
    B. Physical, mechanical, chemical, and electrical properties of nonferrous metals
    C. Physical, mechanical, chemical, and electrical properties of engineered materials (e.g., polymers, concrete, composites)
    D. Corrosion mechanisms and control

12. **Fluid Mechanics and Dynamics of Liquids**   **8–12**
    A. Fluid properties (e.g., Newtonian, non-Newtonian)
    B. Dimensionless numbers (e.g., Reynolds number, Froude number)
    C. Laminar and turbulent flow
    D. Fluid statics
    E. Energy, impulse, and momentum equations (e.g., Bernoulli equation)
    F. Pipe flow and friction losses (e.g., pipes, valves, fittings, Darcy-Weisbach equation, Hazen-Williams equation)
    G. Open-channel flow (e.g., Manning equation, drag)
    H. Fluid transport systems (e.g., series and parallel operations)
    I. Flow measurement
    J. Turbomachinery (e.g., pumps, turbines)

13. **Fluid Mechanics and Dynamics of Gases**   **4–6**
    A. Fluid properties (e.g., ideal and non-ideal gases)
    B. Dimensionless numbers (e.g., Reynolds number, Mach number)
    C. Laminar and turbulent flow
    D. Fluid statics
    E. Energy, impulse, and momentum equations
    F. Duct and pipe flow and friction losses
    G. Fluid transport systems (e.g., series and parallel operations)
    H. Flow measurement
    I. Turbomachinery (e.g., fans, compressors, turbines)

14. **Electricity, Power, and Magnetism**   **7–11**
    A. Electrical fundamentals (e.g., charge, current, voltage, resistance, power, energy)
    B. Current and voltage laws (Kirchhoff, Ohm)
    C. DC circuits
    D. Equivalent circuits (series, parallel, Norton's theorem, Thevenin's theorem)
    E. Capacitance and inductance
    F. AC circuits (e.g., real and imaginary components, complex numbers, power factor, reactance and impedance)
    G. Measuring devices (e.g., voltmeter, ammeter, wattmeter)

15. Heat, Mass, and Energy Transfer
   A. Energy, heat, and work
   B. Thermodynamic laws (e.g., 1st law, 2nd law)
   C. Thermodynamic equilibrium
   D. Thermodynamic properties (e.g., entropy, enthalpy, heat capacity)
   E. Thermodynamic processes (e.g., isothermal, adiabatic, reversible, irreversible)
   F. Mixtures of nonreactive gases
   G. Heat transfer (e.g., conduction, convection, and radiation)
   H. Mass and energy balances
   I. Property and phase diagrams (e.g., T-s, P-h)
   J. Phase equilibrium and phase change
   K. Combustion and combustion products (e.g., CO, CO_2, NO_X, ash, particulates)
   L. Psychrometrics (e.g., relative humidity, wet-bulb)