EXAM SPECIFICATIONS

Fundamentals of Engineering (FE) Examination
Effective October 2005

- The FE examination is an 8-hour supplied-reference examination: 120 questions in the 4-hour morning session and 60 questions in the 4-hour afternoon session.
- The afternoon session is administered in the following seven modules—Chemical, Civil, Electrical, Environmental, Industrial, Mechanical, and Other/General engineering.
- Examinees work all questions in the morning session and all questions in the afternoon module they have chosen.

**MORNING SESSION (120 questions in 12 topic areas)**

<table>
<thead>
<tr>
<th>Topic Area</th>
<th>Percentage of Test Content</th>
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<tbody>
<tr>
<td>Mathematics</td>
<td>15%</td>
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<tr>
<td>A. Analytic geometry</td>
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<tr>
<td>B. Integral calculus</td>
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<tr>
<td>C. Matrix operations</td>
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<tr>
<td>D. Roots of equations</td>
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<tr>
<td>E. Vector analysis</td>
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<td>F. Differential equations</td>
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<tr>
<td>G. Differential calculus</td>
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<tr>
<td>Engineering Probability and Statistics</td>
<td>7%</td>
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<tr>
<td>A. Measures of central tendencies and dispersions (e.g., mean, mode, standard deviation)</td>
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<td>B. Probability distributions (e.g., discrete, continuous, normal, binomial)</td>
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<td>C. Conditional probabilities</td>
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<td>D. Estimation (e.g., point, confidence intervals) for a single mean</td>
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<td>E. Regression and curve fitting</td>
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<td>F. Expected value (weighted average) in decision-making</td>
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<td>G. Hypothesis testing</td>
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<tr>
<td>Chemistry</td>
<td>9%</td>
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<tr>
<td>A. Nomenclature</td>
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<td>B. Oxidation and reduction</td>
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<td>C. Periodic table</td>
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<td>D. States of matter</td>
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<td>E. Acids and bases</td>
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<td>F. Equations (e.g., stoichiometry)</td>
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<td>G. Equilibrium</td>
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<td>H. Metals and nonmetals</td>
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<tr>
<td>Computers</td>
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<tr>
<td>A. Terminology (e.g., memory types, CPU, baud rates, Internet)</td>
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<td>B. Spreadsheets (e.g., addresses, interpretation, “what if,” copying formulas)</td>
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<td>C. Structured programming (e.g., assignment statements, loops and branches, function calls)</td>
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<tr>
<td>Ethics and Business Practices</td>
<td>7%</td>
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<td>A. Code of ethics (professional and technical societies)</td>
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<td>B. Agreements and contracts</td>
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<td>C. Ethical versus legal</td>
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<td>D. Professional liability</td>
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<td>E. Public protection issues (e.g., licensing boards)</td>
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VI. Engineering Economics
A. Discounted cash flow (e.g., equivalence, PW, equivalent annual FW, rate of return)
B. Cost (e.g., incremental, average, sunk, estimating)
C. Analyses (e.g., breakeven, benefit-cost)
D. Uncertainty (e.g., expected value and risk)

VII. Engineering Mechanics (Statics and Dynamics)
A. Resultants of force systems
B. Centroid of area
C. Concurrent force systems
D. Equilibrium of rigid bodies
E. Frames and trusses
F. Area moments of inertia
G. Linear motion (e.g., force, mass, acceleration, momentum)
H. Angular motion (e.g., torque, inertia, acceleration, momentum)
I. Friction
J. Mass moments of inertia
K. Impulse and momentum applied to:
   1. particles
   2. rigid bodies
L. Work, energy, and power as applied to:
   1. particles
   2. rigid bodies

VIII. Strength of Materials
A. Shear and moment diagrams
B. Stress types (e.g., normal, shear, bending, torsion)
C. Stress strain caused by:
   1. axial loads
   2. bending loads
   3. torsion
   4. shear
D. Deformations (e.g., axial, bending, torsion)
E. Combined stresses
F. Columns
G. Indeterminant analysis
H. Plastic versus elastic deformation

IX. Material Properties
A. Properties
   1. chemical
   2. electrical
   3. mechanical
   4. physical
B. Corrosion mechanisms and control
C. Materials
   1. engineered materials
   2. ferrous metals
   3. nonferrous metals

X. Fluid Mechanics
A. Flow measurement
B. Fluid properties
C. Fluid statics
D. Energy, impulse, and momentum equations
E. Pipe and other internal flow
XI. **Electricity and Magnetism**
   A. Charge, energy, current, voltage, power
   B. Work done in moving a charge in an electric field (relationship between voltage and work)
   C. Force between charges
   D. Current and voltage laws (Kirchhoff, Ohm)
   E. Equivalent circuits (series, parallel)
   F. Capacitance and inductance
   G. Reactance and impedance, susceptance and admittance
   H. AC circuits
   I. Basic complex algebra

XII. **Thermodynamics**
   A. Thermodynamic laws (e.g., 1st Law, 2nd Law)
   B. Energy, heat, and work
   C. Availability and reversibility
   D. Cycles
   E. Ideal gases
   F. Mixture of gases
   G. Phase changes
   H. Heat transfer
   I. Properties of:
      1. enthalpy
      2. entropy
Topic Area

I. Surveying
   A. Angles, distances, and trigonometry
   B. Area computations
   C. Closure
   D. Coordinate systems (e.g., GPS, state plane)
   E. Curves (vertical and horizontal)
   F. Earthwork and volume computations
   G. Leveling (e.g., differential, elevations, percent grades)

II. Hydraulics and Hydrologic Systems
   A. Basic hydrology (e.g., infiltration, rainfall, runoff, detention, flood flows, watersheds)
   B. Basic hydraulics (e.g., Manning equation, Bernoulli theorem, open-channel flow, pipe flow)
   C. Pumping systems (water and wastewater)
   D. Municipal water distribution systems
   E. Reservoirs (e.g., dams, routing, spillways)
   F. Groundwater (e.g., flow, wells, drawdown)
   G. Sewer collection systems (storm and sanitary)

III. Soil Mechanics and Foundations
     A. Index properties and soil classifications
     B. Phase relations (air-water-solid)
     C. Laboratory and field tests
     D. Effective stress (buoyancy)
     E. Retaining walls (e.g., active pressure/passive pressure)
     F. Shear strength
     G. Bearing capacity (cohesive and noncohesive)
     H. Foundation types (e.g., spread footings, piles, wall footings, mats)
     I. Consolidation and differential settlement
     J. Seepage
     K. Slope stability (e.g., fills, embankments, cuts, dams)
     L. Soil stabilization (e.g., chemical additives, geosynthetics)

IV. Environmental Engineering
     A. Water quality (ground and surface)
     B. Air quality
     C. Solid/hazardous waste
     D. Sanitary sewer system loads
     E. Basic tests (e.g., water, wastewater, air)
     F. Environmental regulations
     G. Water treatment and wastewater treatment (e.g., primary, secondary, tertiary)
V. Transportation
A. Streets and highways
   1. geometric design
   2. pavement design
   3. intersection design
B. Traffic analysis and control
   1. safety
   2. capacity
   3. traffic flow
   4. traffic control devices

VI. Structural Analysis
A. Force analysis of statically determinant beams, trusses and frames
B. Deflection analysis of statically determinant beams, trusses and frames
C. Stability analysis of beams, trusses and frames
D. Column analysis (e.g., buckling, boundary conditions)
E. Loads and load paths (e.g., dead, live, moving)
F. Elementary statically indeterminate structures

VII. Structural Design
A. Codes (e.g., AISC, ACI, NDS, AISI)
B. Design procedures for steel components (e.g., beams, columns,
   beam-columns, tension members, connections)
C. Design procedures for concrete components (e.g., beams, slabs,
   columns, walls, footings)

VIII. Construction Management
A. Procurement methods (e.g., design-build, design-bid-build, qualifications based)
B. Allocation of resources (e.g., labor, equipment, materials, money, time)
C. Contracts/contract law
D. Project scheduling (e.g., CPM, PERT)
E. Engineering economics
F. Project management (e.g., owner/contractor/client relations, safety)
G. Construction estimating

IX. Materials
A. Concrete mix design
B. Asphalt mix design
C. Test methods (e.g., steel, concrete, aggregates, asphalt)
D. Properties of aggregates
E. Engineering properties of metals
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<tr>
<th>Topic Area</th>
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<tbody>
<tr>
<td><strong>I. Water Resources</strong></td>
<td>25%</td>
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<tr>
<td>A. Water distribution and wastewater collection</td>
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<td>B. Water resources planning</td>
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<td>C. Hydrology and watershed processes</td>
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<td>D. Fluid mechanics and hydraulics</td>
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<tr>
<td><strong>II. Water and Wastewater Engineering</strong></td>
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<td>A. Water and wastewater</td>
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<td>B. Environmental microbiology/ ecology</td>
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<td>C. Environmental chemistry</td>
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<td><strong>III. Air Quality Engineering</strong></td>
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<td>A. Air quality standards and control technologies</td>
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<tr>
<td>B. Atmospheric sciences</td>
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<td><strong>IV. Solid and Hazardous Waste Engineering</strong></td>
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<td>B. Hazardous waste engineering</td>
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<td>C. Site remediation</td>
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<td>D. Geohydrology</td>
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<td>E. Geotechnology</td>
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<td><strong>V. Environmental Science and Management</strong></td>
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<td>A. Industrial and occupational health and safety</td>
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<td>B. Radiological health and safety</td>
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<td>C. Radioactive waste management</td>
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<td>D. Environmental monitoring and sampling</td>
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<td>E. Pollutant fate and transport (air/water/soil)</td>
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<td>F. Pollution prevention and waste minimization</td>
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<td>G. Environmental management systems</td>
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