Professional Engineers Registration Examination
Fundamentals of Engineering Examination 2010

Information for Applicants

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Annex A: FORMAT AND SYLLABUS

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Professional Engineers Registration Examination
Fundamentals of Engineering Examination 2010
Information for Applicants

1 INTRODUCTION

The mission of the Professional Engineers Board is to safeguard life, property, and welfare of the public by setting and maintaining high standards for registering professional engineers and by regulating and advancing the practice of professional engineering.

The Professional Engineers Board registers professional engineers in the branches of civil, electrical and mechanical engineering. A person applying for registration as a professional engineer to the Professional Engineers Board is required to hold an approved degree or qualification listed in the Professional Engineers (Approved Qualifications) Notification and acquired not less than 4 years of relevant practical experience. He is also required to sit and pass examinations prescribed by the Board. The applicant is required to sit and pass the Fundamentals of Engineering Examination and following that, to sit and pass the Practice of Professional Engineering Examination. In addition, the applicant is required to attend an interview.

The following sections set out the requirements and details for the Fundamentals of Engineering Examination 2010 while details on other application requirements are available on the PEB website at www.peb.gov.sg.

2 ELIGIBILITY TO SIT FOR EXAMINATION

The Fundamentals of Engineering Examination tests an applicant's knowledge of fundamental engineering subjects in civil, electrical or mechanical engineering. A person may apply to sit for the Fundamentals of Engineering Examination after he has obtained an approved degree or qualification listed in the Professional Engineers (Approved Qualifications) Notification or has proper and recognised academic qualifications in engineering accepted by the Board.

3 FEES

The fees for an application to sit for the Fundamentals of Engineering Examination is $350.
4   DATES OF EXAMINATION

The dates for the Fundamentals of Engineering Examination 2010 are:

   a)  Civil Engineering – 29 Sep 2010
   b)  Electrical Engineering – 30 Sep 2010
   c)  Mechanical Engineering – 30 Sep 2010

5   VENUE

Details of the venue would be given to successful applicants at a later date.

6   APPLICATION FORMS

Application forms can be downloaded from the PEB website at http://www.peb.gov.sg. All applications are to be submitted to PEB with applicable fees and documents by 30 Jun 2010 latest for the Fundamentals of Engineering Examination. Applicants are advised to send in their applications early to allow time for processing. They would be informed of the status of their applications and other details by post at least two weeks before the examinations.

7   STRUCTURE OF EXAMINATION

A summary of the structure of the Fundamentals of Engineering Examination is shown in the table below. The examination is ‘open book’ and further details are given in Annex A: Format and Syllabus.

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Time Allocated</th>
<th>Format</th>
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<tbody>
<tr>
<td>FEE Part 1 Core engineering</td>
<td>3 hours (9 am</td>
<td>• 40 Multiple Choice Questions (MCQ)</td>
</tr>
<tr>
<td>subjects in civil/mechanical/electrical engineering</td>
<td>12 noon)</td>
<td></td>
</tr>
<tr>
<td>FEE Part 2 Core/Elective subjects</td>
<td>3 hours (2 pm</td>
<td>• Answer 5 out of 9 questions (civil)</td>
</tr>
<tr>
<td>in civil/mechanical/electrical engineering</td>
<td>5 pm)</td>
<td>• Answer 5 out of 7 questions (electrical, mechanical)</td>
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8 FINAL RESULTS AND NOTIFICATION

Examination results will be given to candidates on a Pass/Fail basis. No examination scores or marks will be given to candidates. Examination results are mailed to the candidates within twelve weeks after the examination.

9 EXAMINATION APPEALS

A candidate who has failed the examination may submit a written appeal to review his/her performance together with a payment of $25. The appeal is to be made within 2 weeks after the receipt of results and late appeals would not be considered. The result of the appeal/review will be sent by written mail to the appeal candidate.

10 REVIEW COURSES

The Board does not endorse any review course or material provided as study aides.

11 REFUND OF FEES

Where an applicant who has been accepted is unable to sit for the examination subsequently and informs the Board at least a week before the examination, the Board will refund $100 to the applicant. There will be no refund if the applicant informs the Board less than a week before the examination or is absent from the examination.
Annex A: FORMAT AND SYLLABUS

I Fundamentals Of Engineering Examination (Civil)

The examination will focus on testing the fundamentals of civil engineering. The 6-hour examination will comprise two parts. Part I catering for breadth, will comprise questions on core civil engineering subjects, typical of courses covered during the 1st and 2nd year of a 4-year civil engineering undergraduate course. Part II catering for depth, will comprise more core and elective civil engineering courses covered during the 3rd and 4th year of a 4-year civil engineering undergraduate course.

Format

- **FEE Part 1 (Civil) (3 hours) - 40 MCQ questions**
  - CE 101 Mechanics of Materials
  - CE 102 Structural Mechanics
  - CE 103 Structural Analysis
  - CE 104 Soil Mechanics
  - CE 105 Fluid Mechanics

- **FEE Part 2 (Civil) (3 hours) - 5 out of 9 questions**
  - CE 201 Reinforced and Prestressed Concrete Structures (2 Qs)
  - CE 202 Steel and Composite Structures (2 Qs)
  - CE 203 Geotechnical Engineering (2 Qs)
  - CE 204 Transportation (1 Q)
  - CE 205 Hydraulics and Hydrology (1 Q)
  - CE 206 Environmental Engineering (1 Q)

Syllabus

- **CE 101 Mechanics of Materials**
  - **Mechanics of Materials**
    Strength, stiffness and deformability; Stress-strain relations; ductility and brittle fracture; time-dependent properties; creep, creep rupture; relaxation; cyclic load behaviour.
  - **Concrete Technology**
    Concrete-making materials, properties of fresh and hardened concrete, mixing, placing, and curing, mix design, destructive and non-destructive tests, quality control, durability, and special concrete.
• **Steel**
  Basic metallurgy, mechanical properties and applications, welding technology and corrosion.

• **CE 102 Structural Mechanics**
  **Structural Mechanics**
  Statics and kinetics of particles, equilibrium of rigid bodies, kinematics and plane motion of rigid bodies, analysis of simple trusses and beams, analysis of structural members subjected to tension, compression, torsion, and bending, including such fundamental concepts as stress, strain, and elastic behaviour. Bar forces in compound and complex trusses. Bending moment, shear and axial forces of beams and frames.

• **CE 103 Structural Analysis**
  **Structural Analysis**

• **CE 104 Soil Mechanics**
  Basic geology, unified soil classification system, mechanical properties, effective stress principle, shear strength, compressibility, and seepage and consolidation; Mohr-Coulomb failure criterion (drained and undrained), settlement calculations, rate of consolidation using classical Terzaghi theory.

• **CE 105 Fluid Mechanics**
  **Fluid Statics**
  Fluid properties; hydrostatic pressure and thrust; buoyancy; stability of floating bodies.

  **Fluid Motion**
  Continuity equations; Bernoulli’s equation; linear momentum equation.
- **Similitude**
  Dimensional analysis; design of hydraulic models.

- **CE 201 Reinforced and Prestressed Concrete Structures**
  - **RC Design**

  - **Prestressed Concrete Design**
    Basic concepts of prestressing. Materials and prestressing systems. Prestressed losses and time dependent deformation. Behaviour and design of members subject to flexure, shear and combined axial and bending action.

- **CE 202 Steel and Composite Structures**
  - **Steel Design**

  - **Composite (Steel-Concrete) Design**
    Structural modeling and design concepts. Moment capacity and shear resistance, full and partial connection of composite beams. Design of composite slab. Design of composite columns.

- **CE 203 Geotechnical Engineering**
  - **Slope Stability and Earth Retaining Structures**
    Introduction to slope stability and earth retaining structures; slopes and embankments; earth pressure and retaining structures; deep excavations; calculation of active and passive earth pressures; design considerations pertaining to deep excavations.
- **Foundation Engineering**
  Site investigation and interpretation of soil reports; shallow foundations and deep foundations; selection of appropriate foundation type; capacity and settlement requirements.

- **CE 204 Transportation**

  - **Transportation Engineering**
    Transportation systems, planning and management; geometric design of roads and intersections; design of flexible and rigid pavements.

  - **Traffic Engineering**
    Traffic flow studies; traffic data analysis; traffic management; highway and intersection capacity; traffic signal control. Parking.

- **CE 205 Hydraulics and Hydrology**

  - **Hydraulics**
    Friction and minor losses in pipe flow; pipe and pump systems; pipe network analysis; open channel flow; uniform flow, Manning's equation; critical flow; energy and momentum principles; hydraulic jumps; gradually varied flows, backwater computation.

  - **Hydrology**
    Processes in the hydrologic cycle: basic meteorology, rainfall precipitation, evaporation and transpiration, infiltration, subsurface flow, surface runoff, streamflow measurement and hydrograph analysis; unit hydrograph principles and applications; frequency analysis of rainfall or flood data; reservoir and channel flood routing; urban storm drainage design, flood peak estimation.

- **CE 206 Environmental Engineering**

  - **Environmental Engineering**
    Basic physical, chemical and biological water quality parameters; physical, chemical, and biological processes for water and wastewater treatment; water treatment principles and design; water distribution systems; wastewater collection and pumping systems; wastewater treatment design; pretreatment, primary, secondary, tertiary treatment, and anaerobic digestion.
11  **Fundamentals Of Engineering Examination (Electrical)**

The examination will focus on testing the fundamentals of electrical power engineering. The 6-hour examination will comprise two parts.

**Format**

- **FEE Part 1 (Electrical) (3 hours) - 40 MCQ questions**
  - EE 101  Principles of Power Engineering

- **FEE Part 2 (Electrical) (3 hours) - 5 out of 7 questions**
  - EE 201  Power System Analysis and Utilization

**Syllabus**

- **EE 101  Principles of Power Engineering**
  - **Three-phase Circuits and Systems**

  - **Magnetism and Magnetic Circuits**

  - **Transformers**

  - **AC and DC Machines**

  - **Power Electronics and Drives**
    Introduction to power conversion. Harmonics. AC to DC conversion. DC to DC conversion. DC to AC conversion. DC servo motor drive systems. AC variable-speed induction motor
drive systems. Permanent magnet and stepping motor drive systems.

- **Fundamental of Power System**

- **Power Flow Modelling**

- **EE 201 Power System Analysis and Utilizations**
  - **Active Power and Frequency Control**
  - **Reactive Power and Voltage Control**
    Production and absorption of reactive power. Methods of voltage control. Reactive power and voltage control devices. Application to transmission and distribution systems.
  - **Analysis of Unsymmetrical Faults**
  - **Electric Power Distribution Systems**
  - **Building Services Engineering**
  - **General Protection Principles**
    Basic protection principles. Instrument transformers. Coordination of overcurrent and earth protection for
distribution systems. Pilot-wire differential protection of feeders.

- **Applications of High-voltage Engineering**
III  Fundamentals Of Engineering Examination (Mechanical)

The examination will focus on testing the fundamentals of mechanical engineering. The 6-hour examination will comprise two parts:

Format

• **FEE Part 1 (Mechanical) (3 hours) - 40 MCQ questions**
  - ME 101 Control and Instrumentations
  - ME 102 Dynamics and Vibrations
  - ME 103 Fluid Mechanics
  - ME 104 Mechanics and Materials
  - ME 105 Manufacturing Technology
  - ME 106 Thermodynamics and Heat Transfer

• **FEE Part 2 (Mechanical) (3 hours) - 5 out of 7 questions**
  - ME 201 Control and Instrumentations
  - ME 202 Dynamics and Vibrations
  - ME 203 Fluid Mechanics
  - ME 204 Mechanics and Materials
  - ME 205 Manufacturing Technology
  - ME 206 Thermodynamics and Heat Transfer

Syllabus

• **ME 101/201 Control And Instrumentations**
  - **Modelling of Linear Systems**
    Introduction to control systems. Mathematical modelling of electro-mechanical systems. Transfer functions representation of physical components. Block diagram manipulation.
  
  - **Dynamic Response Analysis**
    Transient response analysis and performance indices. Poles and zeros concept, dominant pole concept of high order systems. Characteristic equation. Steady state errors and system types.
  
  - **Principles of Feedback Control**
- **Root Locus Techniques**

- **Frequency Domain Analysis**

- **Measurement System**
  Models and classification for measurement systems and their time and frequency domain behaviours. Performance specifications.

- **Analog Devices and Measurement**
  Introduction to basic measurement devices for analog signals and measurement principles. Conditioning of analog signals for transmission and processing.

- **Digital Devices and Measurement**
  Fundamental differences between analog and digital systems. Sampling theorem and fundamentals of data acquisition.

- **Sensors**
  Measurement for common engineering applications: position, speed, stress, strain, temperature, vibration and acceleration, pressure and flow. Semiconductor sensors and micromechanical devices.

- **ME 102/202 Dynamics And Vibrations**

  - **Dynamics**
    - **Kinematics of Particle**
      Uniform rectilinear motion; Uniform accelerated rectilinear motion; Rectangular components of velocity and acceleration; Motion relative to a frame in translation; Tangential and normal components; Radial and transverse components. Newton’s second law; Equations of motion; Angular momentum of a particle; Principle of conservation of energy; Principle of conservation of momentum.
Kinematics of Rigid Bodies
General plane motion; Coriolis acceleration. Equations of plane motion for a rigid body; Angular momentum of a rigid body in plane motion; Principle of work and energy for a rigid body; Principle of impulse and momentum for the plane motion of a rigid body; Conservation of angular momentum.

- Mechanical Vibrations
  - Vibration Without Damping
    Simple harmonic motion; Energy method; forced vibration.
  - Damped Vibration
    Damped free vibration; Damped forced vibration.

- ME 103/203 Fluid Mechanics
  - Basic concepts
  - Fluid Motion
    Real and ideal fluids. Momentum and forces in fluid flow: Continuity equation, momentum equation, energy equation, Bernoulli’s equation.
  - Pipe Flow
  - Fluid Machinery
  - Flow Resistance and Propulsion
• ME 104/204 Mechanics And Materials

  ▪ Material properties and behaviour
  Yield and ultimate tensile stress, proof stress, elastic modulus. Yield and Strength failure criteria- Tresca and Von-Mises.

  ▪ Stress and Strain
  Basic stress and strain for elastic bodies- direct stress and strain, shear stress and strain, Mohr's circle. Stress and Strain transformations - two and three-dimensional, 4 elastic constants E, v, k and G.

  ▪ Bending of beams

  ▪ Bending of plates and cylindrical shells
  Symmetric membrane bending theory of circular plates and shells under fixed and freely supported boundaries. Discontinuity stresses of cylinder to flat, cone or hemispherical shells junctions.

  ▪ Torsion of prismatic bars and closed sections
  Torsion of circular solid section and open thin walled sections, shear stresses and deformation, shear flow in thin walled open and closed sections.

  ▪ Buckling of columns
  Euler buckling theory, perfect and imperfect columns, effect of end fixings on critical buckling loads.

  ▪ Thermal loading
  Thermal stresses in beams and cylinders due to a through thickness temperature gradient, thermal stresses in compound bars of different materials under uniform temperature.

  ▪ Internal pressure loading
  Membrane theory, thin and thick walled cylinders under pressure.
• **ME 105/205 Manufacturing Technology**

  ▪ **Introduction**

  ▪ **Metal Removal**
  Introduction to machine tools and machining operations – Generating motions of machine tools, machines using single point tools, machines using multipoint tools, machines using abrasive wheels. Mechanics of metal cutting – Chip formation, forces acting on the cutting tool and their measurement, the apparent mean shear strength of the work material, chip thickness, friction in metal cutting. Cutting tool materials – Major tool material types. Tool life and tool wear – Forms of wear in metal cutting. Economics of metal cutting operations – Choice of feed, speed and depth of cut, tool life for minimum cost and minimum production time, estimation of factors needed to determine optimum conditions.

  ▪ **Metrology**
  Basic measuring instruments and their applications (Linear and angular measurement, roundness, flatness and surface finish measurement).

  ▪ **Manufacturing Processes**
plastics, thermoplastics and thermosets, manufacturing of plastics.

- **ME 106/206 Thermodynamics And Heat Transfer**
  
  - **Thermodynamics**
    
    **Fundamental concepts**
    Simple concept of thermodynamic system. Types of energy interaction between system and surroundings. Properties of simple pure substances - understand the general form of property diagrams. Empirical temperature scales and thermometry. Ideal and perfect gases. Use of steam tables for substance such as water.

  **First Law of Thermodynamics**
  The concept of fully-resisted or quasi-static processes; work and heat interactions in adiabatic boundaries with the introduction of internal energy, kinetic, potential and enthalpy. Statement of the First law of Thermodynamics: applications relating to non-flow and simple unsteady flow (e.g., the filing of a rigid vessel) processes. First law applied to simple thermodynamic plants, e.g. power plant, compressors and expanders (without detailed knowledge of plant construction). Steady flow energy equation and its application to demonstrate the significant of enthalpy changes.

  **Second Law of Thermodynamics**

  - **Heat Transfer**
    
    **Conduction**

    **Convection**
    Heat Transfer by convection, in fluids and films. Overall heat transfer coefficients. Natural and forced convection on plane...
surfaces, fins, pipes and around round bundles. Heat transfer in extended surfaces- combining conduction and convection.

**Radiation**
Heat transfer by radiation. Laws of radiant heat transfer, black and gray bodies, geometric factors, absorptivity and
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Recommended Reading List for Civil Engineering

**FEE Part 1 (Civil)**

**CE101 Mechanics of Materials**

**CE102 Structural Mechanics**

**CE103 Structural Analysis**

**CE104 Soil Mechanics**

**CE105 Fluid Mechanics**

**FEE Part 2 (Civil)**

**CE201 Reinforced and Pre-stressed Concrete Structures**

**CE202 Steel and Composite Structures**


**CE203 Geotechnical Engineering**


**CE204 Transportation**

**CE205 Hydraulics and Hydrology**


**CE206 Environmental Engineering**
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Recommended Reading List for Electrical Engineering

FEE Part 1 (Electrical)
EE 101 Principles of Power Engineering


FEE Part 2 (Electrical)
EE 201 Power System Analysis and Utilizations


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Recommended Reading List for Mechanical Engineering

FEE Part 1 & Part 2 (Mechanical)
ME 101/201 Control and Instrumentations
1) Katsuhiko Ogata, Modern Control Engineering, Prentice Hall
   2) Benjamin Kuo, Automatic Control Systems, Prentice Hall International Editions
   3) A K Sawhney, A Course In Mechanical Measurements And Instrumentations, Dhanpat Rai & Sons

ME 102/202 Dynamics and Vibrations

ME 103/203 Fluid Mechanics

ME 104/204 Mechanics and Materials

ME 105/205 Manufacturing Technology
1) Manufacturing Engineering and Technology 5th Edition by Kalpakjian and Schmid
   2) Fundamentals of Metal Cutting and Machine Tools by Boothroyd and Winston A Knight

ME 106/206 Thermodynamics and Heat Transfer