

Appendix B  
**Coding Six-Minute Items  
(Mechanical PE)**

After you have written each item, decide whether it is a morning **breadth** question or an afternoon **depth** question. A **breadth** question is one in which the item could be solved correctly by someone who has just graduated from a four-year engineering degree program—that is, the knowledge required to solve the problem would normally be taught in such a program. A **depth** question is one for which the solution draws on knowledge that would be learned, encountered, developed, or enhanced after graduation.

For each item, decide on the primary subject tested (e.g., “energy conversion and power systems” or “HVAC and refrigeration”), then assign the item a code from the item classification codes provided in App. C.

Insert the code for the item directly after the item number, using the following format. Use all uppercase letters. Start with ME for “Mechanical,” followed by a D for “depth” or B for “breadth,” followed by the primary subject code, followed by the item classification code. Surround the entire code expression in square brackets. For example,

PROBLEM 3 [ME B GK FPRL]                      or                      PROBLEM 21 [ME D HF HSLI]

Note that some primary subject and item classification codes are the same for both breadth and depth questions.

Appendix C  
**Item Classification Codes**  
**(Mechanical PE - BREADTH)**

GENERAL KNOWLEDGE, CODES, AND STANDARDS (GK) — BREADTH

Engineering Principles	
Heat transfer	ME B GK PRHT
Mass transfer	ME B GK PRMT
Fluid mechanics	ME B GK PRFM
Materials properties	ME B GK PRMP
Other	ME B GK PROT
Fundamental Engineering Practice	
Relevant engineering terminology	ME B GK FPTR
Economic analyses	ME B GK FPEC
Project management	ME B GK FPPM
Ethics	ME B GK FPET
Regulations and laws	ME B GK FPRL
Industry and company design standards	ME B GK FPDS
Interpretation of technical drawings	ME B GK FPTD
Electrical principles	ME B GK FPEP
Other	ME B GK FPOT
Interpretation of Codes and Standards	
ASTM	ME B GK CSAS
ANSI	ME B GK CSAN
ASME	ME B GK CSAM
Other	ME B GK CSOT

ENERGY CONVERSION AND POWER SYSTEMS (EC) — BREADTH

Principles	
Thermodynamic cycles	ME B EC PNTC
Thermodynamic properties	ME B EC PNTP
Other	ME B EC PNOT
Analysis of Systems and Components	
Energy balances	ME B EC SAEB
Pumps and compressors	ME B EC SAPC
Other	ME B EC SAOT

## MACHINE DESIGN AND MATERIALS (MC) — BREADTH

### Principles

Strength of materials	ME B MC PCSM
Fatigue theory	ME B MC PCFT
Statics and dynamics	ME B MC PCSD
Other	ME B MC PCOT

### Applications

Welding	ME B MC APWE
Pressure vessels	ME B MC APPV
Vibration analysis	ME B MC APVA
Materials selection	ME B MC APMS
Corrosion	ME B MC APCO
Economic Analyses	ME B MC APEA
Codes and Standards	ME B MC APCS
Other	ME B MC APOT

## HYDRAULICS AND FLUIDS (HF) — BREADTH

### Principles

Compressible flow	ME B HF PLCF
Incompressible flow	ME B HF PLIF
Stress analysis	ME B HF PLSA

### Applications

Hydraulic pumps	ME B HF HAHP
Pressure loss	ME B HF HAPL
Efficiency	ME B HF HAEF
Other	ME B HF HAOT

## HVAC AND REFRIGERATION (HV) — BREADTH

### Principles, Fundamentals and Psychrometrics

Psychrometrics	ME B HV PSPS
Cooling and heating cycles	ME B HV PSCJ
Thermodynamic cycles	ME B HV PSTC
Thermodynamic properties	ME B HV PSTP
Other	ME B HV PSOT

Appendix C  
**Item Classification Codes**  
**(Mechanical PE - DEPTH)**

MACHINE DESIGN AND MATERIALS (MC) — DEPTH

Principles

Strength of materials	ME D MC PCSM
Fatigue theory	ME D MC PCFT
Statics and dynamics	ME D MC PCSD
Materials properties and selection	ME D MC PCMP
Vibration analysis	ME D MC PCVA
Stress analysis	ME D MC PCSA
Kinematics	ME D MC PCKI
Other	ME D MC PCOT

Applications

Pressure vessels	ME D MC APPV
Structural analysis	ME D MC APSA
Mechanism analysis	ME D MC APMA
Economic Analyses	ME D MC APEA
Codes and Standards	ME D MC APCS
Other	ME D MC APOT

Components

Bearings	ME D MC CPBE
Gears	ME D MC CPGE
Springs	ME D MC CPSP
Shafts	ME D MC CPSH
Fasteners	ME D MC CPFA
Other	ME D MC CPOT

Supportive Knowledges

Fluid mechanics	ME D MC MEFM
Heat and mass transfer principles	ME D MC MEMT
Thermodynamic cycles	ME D MC METC
Thermodynamic properties	ME D MC METP
Energy balances	ME D MC MEEB
Project management	ME D MC MEPM
Welding	ME D MC MEWE
Fits and tolerances	ME D MC MEFT
Manufacturing processes	ME D MC MEMA
Quality control	ME D MC MEQU
Other	ME D MC MEOT

## HYDRAULICS AND FLUIDS (HF) — DEPTH

### Principles

Materials properties	ME D HF PLMP
Fluid mechanics	ME D HF PLFM
Heat and mass transfer principles	ME D HF PLHM
Economic analyses	ME D HF PLEE
Project management	ME D HF PLPM
Thermodynamic cycles	ME D HF PLTC
Thermodynamic properties	ME D HF PLTP
Energy balances	ME D HF PLEB
Other	ME D HF PLOT

### Applications

Cooling and heating cycles	ME D HF HACY
Water distribution systems	ME D HF HAWD
Energy recovery	ME D HF HAER
Compressor processes	ME D HF HACP
Combustion processes	ME D HF HACB
Power systems	ME D HF HAPS
Steam	ME D HF HAST
Gas	ME D HF HAGA
Combined cycles	ME D HF HACO
Internal combustion	ME D HF HAIN
Other	ME D HF HAOT

### Supportive Knowledges

Strength of materials	ME D HF SPSM
Fatigue theory	ME D HF SPFT
Statics and dynamics	ME D HF SPSD
Welding	ME D HF SPWE
Pressure vessels	ME D HF SPPV
Stress analysis	ME D HF SPSA
Psychrometrics	ME D HF SPPS
Codes and standards (ASTM, ANSI, ASME)	ME D HF SPCO
Other	ME D HF SPOT

### Hydraulic System Components

Hydraulic pumps	ME D HF HSPU
Hydraulic and pneumatic lines, fittings, and control components	ME D HF HSLI
Other	ME D HF HSOT

## Power Plant Components

Turbines	ME D HF PPTU
Pumps and compressors	ME D HF PPC
Heat exchangers	ME D HF PPHE
Feedwater heaters	ME D HF PPFH
Cooling towers	ME D HF PPCT
Steam generators	ME D HF PPSG
Condensers	ME D HF PPCO
Other	ME D HF PPOT

## HVAC AND REFRIGERATION (HV) — DEPTH

### Principles, Fundamentals and Psychrometrics

Psychrometrics	ME D HV PSPS
Cooling and heating cycles	ME D HV PSCJ
Humidification and dehumidification	ME D HV PSHD
Fluid mechanics	ME D HV PSFM
Heat and mass transfer principles	ME D HV PSHM
Compression processes	ME D HV PSCP
Compressible flow	ME D HV PSCF
Thermodynamic cycles	ME D HV PSTC
Thermodynamic properties	ME D HV PSTP
Energy balances	ME D HV PSEB
Other	ME D HF PSOT

### Equipment and Materials

Cooling towers	ME D HV EQCT
Boilers and furnaces	ME D HV EQBF
Condensers	ME D HV EQCO
Pumps, compressors, and fans	ME D HV EQPU
Evaporators and chillers	ME D HV EQEV
Cooling and heating coils	ME D HV EQCC
Control systems components	ME D HV EQCS
Refrigerants	ME D HV EQRE
Refrigeration components	ME D HV EQRC
Other	ME D HV EQOT

### Applications

Codes and standards (FM, NFPA, ASHRAE, BOCA, UBC, SBCC, etc.)	ME D HV ALCO
Air distribution systems	ME D HV ALAD
Water distribution systems	ME D HV ALWD
Refrigeration systems	ME D HV ALRS
Air quality requirement	ME D HV ALAQ
Energy recovery	ME D HV ALER
Other	ME D HV ALOT

Supportive Knowledges

Vibration control

Acoustics

Economic analyses

Other

ME D HV SUVC

ME D HV SUAC

ME D HV SUEC

ME D HV SUOT

## **Description of Exam Format and Subjects (Mechanical PE)**

The NCEES Professional Engineering examination in mechanical engineering consists of two four-hour sessions separated by a one-hour lunch period. The morning “breadth” session is taken by all examinees. In the afternoon, the examinee will be able to select from three “depth” modules: HVAC and refrigeration, machine design, and thermal and fluids systems. (The depth modules may be referred to as “discipline specific” (or DS) modules, borrowing a term from the FE exam.) All three depth modules are present in the examination booklet for the examinee to review before making a selection. After the examinee begins working in a depth module, he or she may leave it and begin working in another module. However, the examinee won’t be given any additional time.

Both the morning and afternoon sessions contain 40 questions in multiple-choice (i.e., “objective”) format. As this is a “no-choice” exam, the examinee must answer all questions in each session correctly to receive full credit. There are no optional questions.

### **Exam Subjects**

NCEES has published a description of the examination subjects. Regardless of the published examination structure, the exact number of questions that will appear in each subject area cannot be predicted reliably. There is no guarantee that any single subject will occur in any quantity. One reason for this is that some of the questions span several disciplines. The examinee might consider a pump selection question to come from the subject of fluids, while someone else might categorize it as engineering economics.

Table 1 is the official NCEES listing of the exam format, while Table 2 describes the subjects in detail. Most examinees find the list of subjects to be formidable in appearance. The percentage breakdowns given in Table 1 are according to NCEES, but these percentages are approximate. NCEES adds, “The examination is developed with questions that require a variety of approaches and methodologies including design, analysis, application, and operations. Some questions may require knowledge of engineering economics. These areas are examples of the kinds of knowledge that will be tested but are not exclusive or exhaustive categories.”

**Table 1**  
**Subjects on the Exam and**  
**Approximate Percentages of Questions<sup>a</sup>**  
**(Mechanical PE)**

		AM breadth	PM depth HVAC and refrigeration	PM depth machine design	PM depth thermal and fluids systems
general knowledge	engineering principles	15%			
	fundamental engineering practice	11%			
	codes and standards	4%			
machine design and materials	principles	11%		43%	
	applications and supporting knowledge	6%		21%	
	specific components			36%	
hydraulics and fluids	principles and supporting knowledge	9%			33%
	applications	8%			33%
	components (general and power plant)				34%
energy conversion/ power systems	principles	10%			
	analysis of systems and components	8%			
HVAC and refrigeration	principles, fundamentals and psychrometrics	18%	34%		
	equipment and materials		37%		
	applications and supporting knowledge		29%		

<sup>a</sup> Percentages of questions may be adjusted slightly in order to round the number of questions to whole numbers.

As Table 1 indicates, the subjects in morning and afternoon sessions overlap. However, the depth of required knowledge is not consistent. Table 2 provides some guidance as to what topics each of these options may include.

**Table 2**  
**Detailed Analysis of Tested Subjects**  
**(Mechanical PE)**

Note: NCEES states that these areas are examples of the kinds of knowledge that will be tested but are not exclusive or exhaustive categories.

**MORNING SESSION**  
(40 multiple-choice questions)

**General Knowledge, Codes, and Standards**

Engineering Principles: Heat transfer, Mass transfer, Fluid mechanics, Materials properties  
Fundamental Engineering Practice: Relevant engineering terminology, Economic analyses, Project management, Ethics, Regulations and laws, Industry and company design standards, Interpretation of technical drawings, Electrical principles  
Interpretation of Codes and Standards: ASTM, ANSI, ASME

**Machine Design and Materials**

Principles: Strength of materials, Fatigue theory, Statics and dynamics  
Applications: Welding, Pressure vessels, Vibration analysis, Materials selection, Corrosion, Economics

**Hydraulics and Fluids**

Principles: Compressible flow, Incompressible flow, Stress analysis  
Applications: Hydraulic pumps, Pressure loss, Efficiency

**Energy Conversion and Power Systems**

Principles: Thermodynamic cycles, Thermodynamic properties  
Analysis of Systems and Components: Energy balances, Pumps and compressors

**HVAC and Refrigeration**

Principles: Psychrometrics, Thermodynamics, Cooling and heating cycles

**Table 2**  
(continued)

**AFTERNOON SESSIONS**

(All afternoon depth exams have 40 multiple-choice questions.)

**Mechanical/HVAC and Refrigeration Depth Module**

**Fundamentals**

Psychrometrics: Cooling and heating cycles, Humidification and dehumidification  
Principles: Thermodynamics, Fluid mechanics, Heat transfer principles, Mass transfer principles, Compression processes, Compressible flow, Thermodynamic cycles, Thermodynamic properties, Energy balances,

**Equipment and Materials**

Cooling towers, Boilers and furnaces, Condensers, Pumps, compressors, and fans, Evaporators and chillers, Cooling and heating coils, Control systems components, Refrigerants, Refrigeration components

**Applications**

System Applications: Codes and standards (FM, NFPA, ASHRAE, BOCA, UBC, SBCC, etc.), Air distribution systems, Water distribution systems, Refrigeration systems, Air quality requirement, Energy recovery  
Supportive Knowledges: Vibration control, Acoustics, Economic analyses

**Mechanical/Machine Design Depth Module**

**Engineering Principles**

Materials properties and selection, Strength of materials, Fatigue theory, Vibration analysis, Statics and dynamics, Stress analysis, Kinematics

**Components**

Bearings, Gears, Springs, Shafts, Fasteners

**Applications**

Systems Applications: Economic analyses, Pressure vessels, Structural analysis, Mechanism analysis, Codes and standards (ASTM, ANSI, ASME)  
Supportive Knowledges: Fluid mechanics, Heat and mass transfer principles, Mass transfer principles, Thermodynamic cycles, Thermodynamic properties, Energy balances, Project management, Welding, Fits and tolerances, Manufacturing processes, Quality control

**Mechanical/Thermal and Fluids Systems Depth Module**

**Fundamentals**

Engineering Principles: Materials properties, Fluid mechanics, Heat transfer principles, Mass transfer principles, Economic analyses, Project management, Compressible flow, Incompressible flow, Thermodynamic cycles, Thermodynamic properties, Energy balances  
Supportive Knowledges: Strength of materials, Fatigue theory, Statics and dynamics, Welding, Pressure vessels, Stress analysis, Psychrometrics

**Components**

Hydraulic System Components: Hydraulic pumps, Hydraulic and pneumatic lines, fittings, and control components

Power Plant Components: Turbines, Pumps and compressors, Heat exchangers, Feedwater heaters, Cooling towers, Steam generators, Condensers

**Applications**

Systems Applications: Cooling and heating cycles, Water distribution systems, Energy recovery, Compressor processes, Combustion processes, Power systems, Steam, Gas, Combined cycles, Internal combustion,

Applications and Supportive Knowledge: Standards and codes (ASTM, ANSI, ASME)