

Appendix B  
**Coding Six-Minute Items  
(Electrical & Computer 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., “General Electrical Engineering” or “Computer Software”), 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 EE for “Electrical & Computer Engineering,” 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 [EE B EE SASA]                      or                      PROBLEM 21 [EE D CS DVPI]

Appendix C  
**Item Classification Codes**  
**(Electrical & Computer PE—Breadth)**

GENERAL ELECTRICAL ENGINEERING (EE) — BREADTH

Professionalism and engineering economics	
Engineering economics	EE B EE PFEC
Ethics	EE B EE PFET
Professional practice	EE B EE PFPP
Other	EE B EE PFOT
Safety and reliability	
Reliability	EE B EE SARE
Electric shock and burns	EE B EE SAEL
General public safety	EE B EE SASA
Other	EE B EE SAOT
Electric circuits	
Ohm's Law	EE B EE ECOH
Coloumb's Law	EE B EE ECCO
Faraday's Law	EE B EE ECFA
Kirchoff's Laws	EE B EE ECKI
Thevenin's Theorem	EE B EE ECTH
Norton's Theorem	EE B EE ECNO
Superposition	EE B EE ECSP
Source transformation	EE B EE ECTR
Sinusoidal steady-state analysis	EE B EE ECSS
Power and energy calculations	EE B EE ECCA
Transient analysis	EE B EE ECTA
Fourier analysis	EE B EE ECFO
Transfer functions	EE B EE ECTF
Complex impedance	EE B EE ECCI
Laplace transforms	EE B EE ECLT
Mutual inductance	EE B EE ECMU
Other	EE B EE ECOT
Electric and magnetic field theory and applications	
Electrostatic effects	EE B EE FTES
Magnetostatic fields	EE B EE FTMG
Other	EE B EE FTOT
Digital logic	
Digital Logic	EE B EE DLDL
Other	EE B EE DLOT

ELECTRONICS, ELECTRONIC CIRCUITS,  
AND COMPONENTS (EL) — BREADTH

Components and Circuits

Solid-state device characteristics, ratings and application	EE B EL CMSO
Transistors	EE B EL CMTR
Signal grounding	EE B EL CMSI
Transducers/sensors	EE B EL CMTD
Amplifiers	EE B EL CMAM
Other	EE B EL CMOT
Electrical and electronic materials	
Conductivity/resistivity	EE B EL EMCO
Thermal characteristics	EE B EL EMTC
Semiconductors	EE B EL EMSE
Other	EE B EL EMOT

CONTROL AND COMMUNICATION SYSTEMS (CC) — BREADTH

Control system fundamentals	
System stability	EE B CC CNSS
Frequency response	EE B CC CNFR
Analog modulation	EE B CC CNAN
Frequency selective filters	EE B CC CNFF
Other	EE B CC CNOT

POWER TRANSMISSION AND DISTRIBUTION (PW) — BREADTH

Transmission and distribution	
Voltage reduction	EE B PW TDVR
Power factor correction	EE B PW TDFC
Grounding	EE B PW TDGR
Other	EE B PW TDOT
Rotating machines and electromagnetic devices	
AC and DC machines	EE B PW RMAD
Transformers	EE B PW RMTR
Other	EE B PW RMOT

## Item Classification Codes (Electrical & Computer PE—Depth)

### GENERAL ELECTRICAL ENGINEERING (EE) — DEPTH

#### Measurement and instrumentation

Transducer characteristics	EE D EE MITR
Frequency response	EE D EE MIFR
Quantization	EE D EE MIQU
Data evaluation	EE D EE MIDE
Sampling theory	EE D EE MISA
Other	EE D EE MIOT

#### Interpretation of codes and standards

ANSI standards	EE D EE CSAN
NEC (code)	EE D EE CSNE
IEEE standards	EE D EE CSIE
FCC standards	EE D EE CSFC
EIA standards	EE D EE CSIA
ISA standards	EE D EE CSIS
ISO standards	EE D EE CSSO
Other	EE D EE CSOT

#### Computer Systems

Programmable Logic Devices	EE D EE COPR
Computer Networks	EE D EE COCO
Number Systems and Codes	EE D EE CONS
Digital Electronic Devices	EE D EE CODI
Other	EE D EE COOT

ELECTRONICS, ELECTRONIC CIRCUITS,  
AND COMPONENTS (EL) — DEPTH

Components and Circuits

Programmable logic devices	EE D EL CMLD
Programmable gate arrays	EE D EL CMGA
Battery characteristics and ratings	EE D EL CMBA
Power supplies	EE D EL CMPO
Phase locked loops	EE D EL CMPH
Oscillators	EE D EL CMOS
Amplifiers	EE D EL CMAM
Modulators and demodulators	EE D EL CMMO
Discrete components	EE D EL CMCO
Diodes	EE D EL CMDI
Circuit protection	EE D EL CMCI
Relays and switches	EE D EL CMRE
Logic components (properties, fan-in, fan-out, propagation delay)	EE D EL CMLO
Other	EE D EL CMOT

Electrical circuit theory

Small signal and large signal	EE D EL CTSS
Active networks and filters	EE D EL CTAC
Delay	EE D EL CTDE
Distributed parameter circuits	EE D EL CTDP
Nonlinear circuits	EE D EL CTNL
Two-port theory	EE D EL CTPP
Phase delay	EE D EL CTPH
Other	EE D EL CTOT

Electric and magnetic field theory and applications

Microwave systems	EE D EL FTMI
Transmission line models	EE D EL FTTR
Electromagnetic fields and interference	EE D EL FTEL
Antennas	EE D EL FTAN
Free-space propagation	EE D EL FTFR
Guided wave propagation	EE D EL FTWA
Other	EE D EL FTOT

## CONTROL AND COMMUNICATION SYSTEMS (CC)—DEPTH

Control system fundamentals	
Difference equations	EE D CC CNDI
z-transform	EE D CC CNZT
Characteristic equations	EE D CC CNCH
Block diagrams	EE D CC CNBL
State variable analysis	EE D CC CNST
Other	EE D CC CNOT
Control System Design and Implementation	
Compensators	EE D CC CPCP
Feed forward	EE D CC CPFF
Feedback	EE D CC CPFB
Optimal control systems	EE D CC CPOP
Adaptive control	EE D CC CPAD
Computer control and monitoring	EE D CC CPCC
Error-actuated control	EE D CC CPEA
Proportional-integral-derivative control	EE D CC CPPU
Other	EE D CC CPOT
Stability	
Stability analysis and design (Nyquist stability, root locus, Bode diagrams)	EE D CC STAD
Pole and zones	EE D CC STZO
Phase and gain margin	EE D CC STMA
Transport delay	EE D CC STTR
Other	EE D CC STOT
Communications and signal processing	
Modulation theory (linear, angle, and pulse modulation)	EE D CC SPMO
Correlation and convolution	EE D CC SPCC
Fourier transforms	EE D CC SPFR
Spectral properties	EE D CC SPSP
Signal processing	EE D CC SPSI
Digital transmission	EE D CC SPDI
Quadrature amplitude modulation	EE D CC SPQU
Personal communication system	EE D CC SPPE
Spread spectrum modulation	EE D CC SPSM
Adaptive filtering	EE D CC SPAD
Nyquist sampling theorem	EE D CC SPNY
Other	EE D CC SPOT

Noise and interference	
Signal-to-noise ratio	EE D CC NOSN
Quantization noise	EE D CC NOQU
Noise figure and temperature	EE D CC NOFT
Aliasing	EE D CC NOAL
Random variables	EE D CC NORV
Error detection and correction	EE D CC NOER
Other	EE D CC NOOT
Telecommunications	
Wireless communications	EE D CC TLWC
Wireline communications	EE D CC TLWL
Compression	EE D CC TLCM
Cellular communications	EE D CC TLCE
Optical communications	EE D CC TLOP
Circuit and packet switching	EE D CC TLCP
Network distribution systems	EE D CC TLNT
Other	EE D CC TLOT

#### POWER TRANSMISSION AND DISTRIBUTION (PW) — DEPTH

Measurement, instrumentation, and statistics	
Power metering	EE D PW MEME
Instrument transformers	EE D PW MEIN
Transducers	EE D PW METR
Frequency responses of measurement devices	EE D PW MEFR
Data evaluation	EE D PW MEDE
Reliability	EE D PW MERE
Other	EE D PW MEOT
System analysis	
Voltage drop and voltage regulation	EE D PW SYVO
Power factor correction	EE D PW SYPW
Parallel three-phase systems	EE D PW SYPA
Surge protection	EE D PW SYSR
Power quality	EE D PW SYPQ
Fault current analysis	EE D PW SYFA
Grounding	EE D PW SYGR
Resistance grounding	EE D PW SYRE
Transformer connections	EE D PW SYTR
Models	EE D PW SYMO
Other	EE D PW SYOT

Power system performance	
Load flow	EE D PW PWFL
Models	EE D PW PWMO
Power system stability	EE D PW PWSS
Voltage profile	EE D PW PWVO
Computer control and monitoring	EE D PW PWCM
Other	EE D PW PWOT
Protection	
Overcurrent protection	EE D PW PROC
Protective relaying	EE D PW PRRE
Protective devices	EE D PW PRDE
Coordination	EE D PW PRCO
Other	EE D PW PROT
Special applications	
Illumination design	EE D PW APIL
Lightning and surge protection	EE D PW APPR
Other	EE D PW APOT
Codes and standards	
ANSI standards	EE D PW CSAN
NEC (code)	EE D PW CSNE
IEEE standards	EE D PW CSIE
NEMA standards	EE D PW CSMA
NESC (code)	EE D PW CSSC
Other	EE D PW CSOT

#### CIRCUIT ANALYSIS (CA) — DEPTH

Analysis	
Short-circuit analysis	EE D CA ANSC
Wye-Delta transformation	EE D CA ANWY
Three-phase circuit analysis	EE D CA ANCA
Symmetrical components	EE D CA ANSY
Balanced and unbalanced systems	EE D CA ANBS
Per-unit analysis	EE D CA ANPU
Other	EE D CA ANOT
Devices and power electronic circuits	
Solid-state power device characteristics and ratings	EE D CA DESS
Battery characteristics and ratings	EE D CA DEBA
Power supplies	EE D CA DEPS
Relays and switches	EE D CA DERS
Power electronics	EE D CA DEPE
Other	EE D CA DEOT

Electric and magnetic fields and applications	
Transmission line models	EE D CA EFTR
Mechanical forces between components	EE D CA EFFO
Electromagnetic fields, coupling, and interference	EE D CA EFFI
Electrostatics	EE D CA EFST
Ferroresonance	EE D CA EFR
Other	EE D CA EFOT

#### ROTATING MACHINES AND ELECTROMAGNETIC DEVICES (RO) — DEPTH

Rotating machines	
Synchronous machines	EE D RO MASY
Induction machines	EE D RO MAIN
DC machines	EE D RO MADC
Machine constants and nameplate data	EE D RO MACO
Equivalent circuits	EE D RO MAEQ
Response times	EE D RO MARE
Speed-torque characteristics	EE D RO MAST
Speed control	EE D RO MASC
Motor starting	EE D RO MAMO
Variable speed drives	EE D RO MAVS
Testing	EE D RO MATE
Other	EE D RO MAOT
Electromagnetic devices	
Transformers	EE D RO EDTR
Reactors	EE D RO EDRE
Magnetic circuit theory	EE D RO EDMA
Testing	EE D RO EDTE
Other	EE D RO EDOT

#### COMPUTER SYSTEMS (CS) — DEPTH

Interpretation of codes and standards	
IEEE standards	EE D CS CSIE
ISO standards	EE D CS CSIS
Other	EE D CS CSOT

Microprocessor systems	
Number systems and codes	EE D CS MPNU
Components	EE D CS MPCO
Control applications	EE D CS MPCA
Math applications	EE D CS MPMA
Programmable logic controllers	EE D CS MPLC
Real-time operations	EE D CS MPRT
Other	EE D CS MPOT

## COMPUTER HARDWARE (CH) — DEPTH

Digital electronics	
Memory devices	EE D CH DIME
Medium-scale integration devices	EE D CH DIND
Programmable logic devices and gate arrays	EE D CH DIGA
Tristate logic	EE D CH DILO
Digital electronic devices	EE D CH DIDE
Logic components (properties, fan-in, fan-out, propagation delay)	EE D CH DICO
Large-scale integration	EE D CH DIIN
Analog to digital and digital to analog conversion	EE D CH DIAD
Other	EE D CH DIOT
Design and analysis	
Clock generation/distribution	EE D CH DACL
Memory interface	EE D CH DAME
Processor interfacing	EE D CH DAPR
Asynchronous communication	EE D CH DAAC
Metastability	EE D CH DAMS
Races and hazards	EE D CH DARH
State transition tables	EE D CH DATA
State transition diagrams	EE D CH DADI
Algorithmic state machine charts	EE D CH DAAL
Timing diagrams	EE D CH DATI
Synchronous state machines	EE D CH DASY
Asynchronous state machines	EE D CH DAAS
Pipelining and parallel processing	EE D CH DAPP
Fault tolerance	EE D CH DAFT
Sampling theory	EE D CH DAST
Other	EE D CH DAOT

Computer Systems	
Digital signal processor architecture	EE D CH SSDS
Design for testability	EE D CH SSTS
Computer architecture	EE D CH SSCO
Mass storage devices	EE D CH SSMS
Input/output devices	EE D CH SSIO
Central processing unit architecture	EE D CH SSAR
Other	EE D CH SSOT

#### COMPUTER SOFTWARE (SF) — DEPTH

System software	
Computer security	EE D SF SMSC
Real-time operating systems	EE D SF SMRT
Computer architecture	EE D SF SMAR
Error detection and control	EE D SF SMER
Drivers	EE D SF SMDR
Time-critical scheduling	EE D SF SMTC
Other	EE D SF SMOT
Development/applications	
Computer control and monitoring	EE D SF DVCM
Software lifecycle (requirements definition, specification, design, implementation, and debugging, testing, maintenance and upgrade)	EE D SF DVLF
Fault tolerance	EE D SF DVFT
Modeling and simulation	EE D SF DVMS
Software pipelining	EE D SF DVPI
Human interface requirements	EE D SF DVHU
Software design methods and documentation (structured programming, top-down or bottom-up programming, successive refinement, programming specifications, program testing, structure diagrams, recursion)	EE D SF DVMD
Object-oriented design	EE D SF DVOO
Data structures (internal, external)	EE D SF DVDS
Other	EE D SF DVOT

#### COMPUTER NETWORKS (CN) — DEPTH

Protocols (TCP/IP, Ethernet)	EE D CN NTPR
OSI model	EE D CN NTMO
Topology	EE D CN NTTO
Technology	EE D CN NTTE
Security	EE D CN NTSE
Other	EE D CN NTOT

## **Description of Exam Format and Subjects (Electrical & Computer PE)**

The NCEES Professional Engineering examination in electrical and computer 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: Computer Engineering; Electronics, Controls, and Communication Engineering; and Power Engineering. (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>**  
**(Electrical & Computer PE)**

	AM breadth	PM depth computers	PM depth electronics, controls, and communications	PM depth power
basic electrical engineering	45%		10%	
electronics, electronics circuits and components	20%		35%	
controls and communications systems	15%		55%	
power	20%			
general computer systems		10%		
hardware		45%		
software		35%		
networks		10%		
general power engineering				15%
circuit analysis				28%
rotating machines and electromagnetic devices				27%
transmission and distribution				30%

<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**  
**(Electrical & Computer 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)

**Basic Electrical Engineering**

Professionalism and engineering economics: Engineering economics, Ethics, Professional practice  
Safety and reliability: Reliability, Electric shock and burns, General public safety  
Electric circuits: Ohm's Law, Coloumb's Law, Faraday's Law, Kirchoff's Laws, Thevenin's Theorem, Norton's Theorem, Superposition, Source transformation, Sinusoidal steady-state analysis, Power and energy calculations, Transient analysis, Fourier analysis, Transfer functions, Complex impedance, Laplace transforms, Mutual inductance  
Electric and magnetic field theory and applications: Electrostatic effects, Magnetostatic fields  
Digital logic

**Electronics, Electronic Circuits, and Components**

Components: Solid-state device characteristics and ratings, Operational amplifiers, Transistors, Signal grounding, Transducers/sensors  
Electrical and electronic materials: Conductivity/resistivity, Thermal characteristics, Semiconductors

**Control and Communication Systems**

System stability, Frequency response, Analog modulation, Frequency selective filters

**Power**

Transmission and distribution: Voltage reduction, Power factor correction, Grounding  
Rotating machines and electromagnetic devices: AC and DC machines, Transformers

**Table 2**  
(continued)

**AFTERNOON SESSIONS**

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

**Computer Engineering Module**

**General Computer Systems**

Interpretation of codes and standards: IEEE standards, ISO standards

Microprocessor systems: Number systems and codes, Microprocessor systems (components, control applications, math applications, programmable logic controllers, real-time operations)

**Hardware**

Digital electronics: Memory devices, Medium-scale integration devices, Programmable logic devices and gate arrays, Tristate logic, Digital electronic devices, Logic components: properties, fan-in, fan-out, propagation delay, Large-scale integration, Analog to digital and digital to analog conversion

Design and analysis: Clock generation/distribution, Memory interface, Processor interfacing, Asynchronous communication, Metastability, Races and hazards, State transition tables, State transition diagrams, Algorithmic state machine charts, Timing diagrams, Synchronous state machines, Asynchronous state machines, Pipelining and parallel processing, Fault tolerance, Sampling theory

Systems: Digital signal processor architecture, Design for testability, Computer architecture, Mass storage devices, Input/output devices, Central processing unit architecture

**Software**

System software: Computer security, Real-time operating systems, Computer architecture, Error detection and control, Drivers, Time-critical scheduling

Development/applications: Computer control and monitoring, Software lifecycle (requirements definition, specification, design, implementation, and debugging, testing, maintenance and upgrade), Fault tolerance, Modeling and simulation, Software pipelining, Human interface requirements, Software design methods and documentation (structured programming, top-down or bottom-up programming, successive refinement, programming specifications, program testing, structure diagrams, recursion), Object-oriented design, Data structures (internal, external)

**Networks**

Protocols (TCP/IP, Ethernet), Computer networks (OSI model, network topology, network technology, network security)

## **Electronics, Control, and Communication Module**

### **General Electrical Engineering Knowledge**

Measurement and instrumentation: Transducer characteristics, Frequency response, Quantization, Data evaluation, Sampling theory  
Interpretation of codes and standards: ANSI standards, NEC (code), IEEE standards, FCC standards, EIA standards, ISA standards, ISO standards  
Computer systems: Programmable logic devices, Computer networks, Number systems and codes, Digital electronic devices

### **Electronics**

Electrical circuit theory: Small signal and large signal, Active networks and filters, Delay, Distributed parameter circuits, Nonlinear circuits, Two-port theory, Phase delay  
Electric and magnetic field theory and applications: Microwave systems, Transmission line models, Electromagnetic fields and interference, Antennas, Free-space propagation, Guided wave propagation  
Electronic components and circuits: Programmable logic devices, Programmable gate arrays, Solid-state power devices and applications, Battery characteristics and ratings, Power supplies, Phase locked loops, Oscillators, Amplifiers, Modulators and demodulators Discrete components, Diodes, Circuit protection, Relays and switches, Logic components (properties, fan-in, fan-out, propagation delay), Transistors and applications

### **Controls**

Control system fundamentals: Difference equations, z-transform, Frequency response, Characteristic equations, Block diagrams, State variable analysis  
Control system design/implementation: Compensators, Feed forward, Feedback, Optimal control systems, Adaptive control, Computer control and monitoring, Error-actuated control, Proportional-integral-derivative control  
Stability: Stability analysis and design (Nyquist stability, root locus, Bode diagrams), Pole and zeros, Phase and gain margin, Transport delay

### **Communications**

Communications and signal processing: Modulation theory (linear, angle, and pulse modulation), Correlation and convolution, Fourier transforms, Spectral properties, Signal processing, Digital transmission, Quadrature amplitude modulation, Personal communication system, Spread spectrum modulation, Adaptive filtering, Nyquist sampling theorem  
Noise and interference: Signal-to-noise ratio, Quantization noise, Noise figure and temperature, Aliasing, Random variables, Error detection and correction  
Telecommunications: Wireless communications, Compression, Cellular communications, Optical communications, Circuit and packet switching, Network distribution systems, Wireline communications

## **Power Module**

### **General Power Engineering: approx. 15% of problems**

Measurement, instrumentation, and statistics: Power metering, Instrument transformers, Transducers, Frequency responses of measurement devices, Data evaluation, Reliability

Special applications: Illumination design, Lightning and surge protection

Codes and standards: ANSI standards, NEC (code), IEEE standards, NEMA standards, NESC (code)

### **Circuit analysis**

Analysis: Short-circuit analysis, Wye-Delta transformation, Three-phase circuit analysis, Symmetrical components, Balanced and unbalanced systems, Per-unit analysis

Devices and power electronic circuits: Solid-state power device characteristics and ratings, Battery characteristics and ratings, Power supplies, Relays and switches, Power electronics

Electric and magnetic fields and applications: Transmission line models, Mechanical forces between components, Electromagnetic fields, coupling, and interference, Electrostatics, Ferroresonance

### **Rotating Machines and Electromagnetic Devices**

Rotating machines: Synchronous machines, Induction machines, DC machines, Machine constants and nameplate data, Equivalent circuits, Response times, Speed-torque characteristics, Speed control, Motor starting, Variable speed drives, Testing

Electromagnetic devices: Transformers, Reactors, Magnetic circuit theory, Testing

### **Transmission and Distribution:**

System analysis: Voltage drop and voltage regulation, Power factor correction, Parallel three-phase systems, Surge protection, Power quality, Fault current analysis, Grounding, Resistance grounding, Transformer connections, Models

Power system performance: Load flow, Models, Power system stability, Voltage profile, Computer control and monitoring

Protection: Overcurrent protection, Protective relaying Protective devices, Coordination