



FE 

**electrical
and computer**
practice exam

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About NCEES

NCEES is a nonprofit organization made up of the U.S. engineering and surveying licensing boards in all 50 states, U.S. territories, and the District of Columbia. We develop and score the exams used for engineering and surveying licensure in the United States. NCEES also promotes professional mobility through its services for licensees and its member boards.

Engineering licensure in the United States is regulated by licensing boards in each state and territory. These boards set and maintain the standards that protect the public they serve. As a result, licensing requirements and procedures vary by jurisdiction, so stay in touch with your board (ncees.org/licensing-boards).

Exam Format

The FE exam contains 110 questions and is administered year-round via computer at approved Pearson VUE test centers. A 6-hour appointment time includes a tutorial, the exam, and a break. You'll have 5 hours and 20 minutes to complete the actual exam.

In addition to traditional multiple-choice questions with one correct answer, the FE exam uses common alternative item types such as

- Multiple correct options—allows multiple choices to be correct
- Point and click—requires examinees to click on part of a graphic to answer
- Drag and drop—requires examinees to click on and drag items to match, sort, rank, or label
- Fill in the blank—provides a space for examinees to enter a response to the question

To familiarize yourself with the format, style, and navigation of a computer-based exam, view the demo on ncees.org/ExamPrep.

Examinee Guide

The *NCEES Examinee Guide* is the official guide to policies and procedures for all NCEES exams. During exam registration and again on exam day, examinees must agree to abide by the conditions in the *Examinee Guide*, which includes the CBT Examinee Rules and Agreement. You can download the *Examinee Guide* at ncees.org/exams. It is your responsibility to make sure you have the current version.

Scoring and reporting

Exam results for computer-based exams are typically available 7–10 days after you take the exam. You will receive an email notification from NCEES with instructions to view your results in your MyNCEES account. All results are reported as pass or fail.

Updates on exam content and procedures

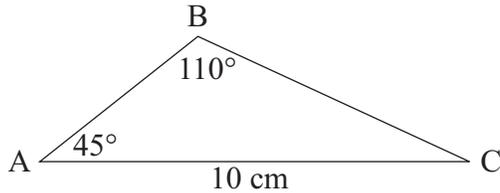
Visit us at ncees.org/exams for updates on everything exam-related, including specifications, exam-day policies, scoring, and corrections to published exam preparation materials. This is also where you will register for the exam and find additional steps you should follow in your state to be approved for the exam.



PRACTICE EXAM

FE ELECTRICAL AND COMPUTER PRACTICE EXAM

1. In the following triangle, the length (cm) of Side AB is most nearly:



- A. 4.5
- B. 7.1
- C. 7.5
- D. 192
2. The term $\frac{(1-i)^2}{(1+i)^2}$, where $i = \sqrt{-1}$ is most nearly:
- A. $1 + i$
- B. 0
- C. $-1 + i$
- D. -1
3. Consider two sets, A and B, where Set A has four elements and Set B has five elements. A function $f(x)$ that maps Set A to Set B, where each element of A is mapped to a unique element of B, is:
- Select **all** that apply:
- A. injective
- B. surjective
- C. bijective
- D. the inverse of the function mapping B to A
- E. an invalid general function

FE ELECTRICAL AND COMPUTER PRACTICE EXAM

14. You have a fair coin that you toss ten times. The probability of getting exactly four heads in ten tosses is most nearly:

- A. 0.1
- B. 0.2
- C. 0.4
- D. 0.5

15. An engineer has been asked to evaluate several projects for planning the following fiscal year. The probability of success and the payoff of the project, if successful, are shown. Given these values, rank the projects from lowest to highest expected payoff.

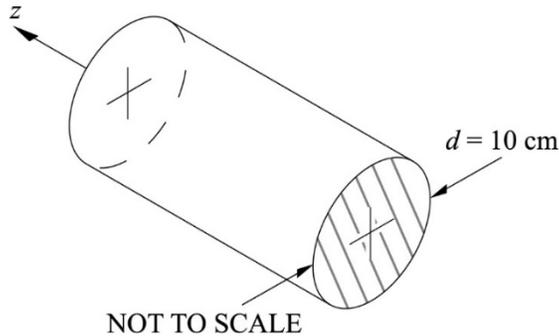
Project	Probability of Success	Payoff	Ranking (lowest to highest)
Project A	40%	\$3,500,000	<input type="text"/>
Project B	65%	\$1,250,000	<input type="text"/>
Project C	75%	\$2,750,000	<input type="text"/>

16. You are a student and have an on-site job interview with Company A. Just before you fly to the interview, you get a call from Company B asking you to come for an on-site interview at their offices in the same city. When you inform them of your interview with Company A, they suggest you stop in after that. Company A has already paid for your airfare and, at the conclusion of your interview with them, issues you reimbursement forms for the balance of your trip expenses with instructions to file for all of your trip expenses. When you inform them of your added interview stop at Company B, they tell you to go ahead and charge the entire cost of the trip to Company A. You interview with Company B, and at the conclusion, they give you travel reimbursement forms with instructions to file for all of your trip expenses. When you inform them of the instructions of Company A, they tell you that the only expenses requiring receipts are airfare and hotel rooms, so you should still file for all the other expenses with them even if Company A is paying for it because students always need a little spending money. What should you do?

- A. File for travel expenses with only one firm.
- B. Do as both recruiting officers told you. It is their money and their travel policies.
- C. File for travel expenses from both firms so you receive double your expense cost.
- D. Tell all of your classmates to sign up to interview with these firms for the trips.

FE ELECTRICAL AND COMPUTER PRACTICE EXAM

25. The solid cylindrical conductor shown below carries a uniform direct current with a density of 100 A/m^2 in the positive z direction. Assume the resistivity is $0.1 \text{ } \Omega \cdot \text{m}$.

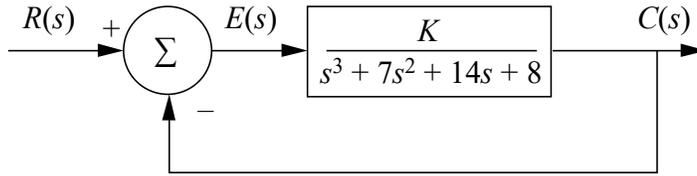


The power loss (W) per meter of length is most nearly:

- A. 2.50
 - B. 3.93
 - C. 7.85
 - D. 31.42
26. At 80°F the contact potential for a given p-n junction is 0.026 V . If the temperature is raised to 180°F , the increase (mV) in the contact potential will be _____.
- Enter your response in the blank.
27. A section of copper has resistivity of $10 \text{ } \Omega \cdot \text{m}$ at 20°C . The temperature coefficient of copper is $0.004041 \text{ } \Omega/^\circ\text{C}$. If the temperature is increased to 30°C , the resistivity ($\Omega \cdot \text{m}$) is most nearly:
- A. 8.96
 - B. 10.04
 - C. 11.04
 - D. 11.20

FE ELECTRICAL AND COMPUTER PRACTICE EXAM

72. A unity-feedback control system is shown in the figure below.

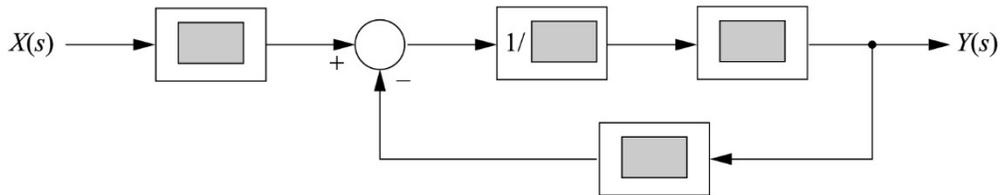


The number of poles in the open-loop characteristic equation for this system is most nearly:

- A. 0
 - B. 1
 - C. 2
 - D. 3
73. The transfer function for the block diagram below is given by:

$$\frac{Y(s)}{X(s)} = \frac{B(s) C(s)}{D(s) + A(s) C(s)}$$

Place the functions for $A(s)$, $B(s)$, $C(s)$, and $D(s)$ in the correct shaded locations on the block diagram.



Functions:

SOLUTIONS

FE ELECTRICAL AND COMPUTER SOLUTIONS

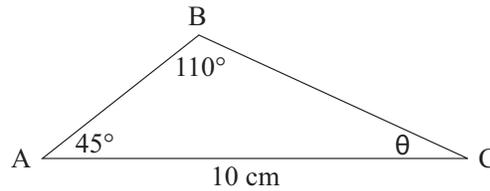
1. Refer to the Law of Sines equation in the Mathematics chapter of the *FE Reference Handbook*.

$$\theta = 180 - 110 - 45 = 25^\circ$$

Law of Sines:

$$\frac{10}{\sin 110^\circ} = \frac{AB}{\sin 25^\circ}$$

$$AB = 4.497 \text{ cm}$$



THE CORRECT ANSWER IS: A

2. Refer to the Algebra of Complex Numbers section in the Mathematics chapter of the *FE Reference Handbook*.

$$\frac{(1 - i)^2}{(1 + i)^2} = \frac{1 - 2i + i^2}{1 + 2i + i^2} = \frac{1 - 1 - 2i}{1 - 1 + 2i} = \frac{-i}{i} = -1$$

THE CORRECT ANSWER IS: D

3. The definitions of injective, surjective, and bijective functions are given in the Discrete Math section in the Mathematics chapter of the *FE Reference Handbook*.

Since no element of B is a function of more than a single element of A, there is a one-to-one (i.e., injective) relationship from A to B. $f(x)$ cannot be surjective since at least one element of B does not map from any element of A. Since it cannot be surjective, it is, by definition, not bijective. Since there is a one-to-one mapping from A to B, the inverse of $f(x)$, or $f^{-1}(x)$, maps B to A. The function is a valid general function since no element of A maps to more than one element of B.

THE CORRECT ANSWERS ARE: A, D

FE ELECTRICAL AND COMPUTER SOLUTIONS

13. Calculate distance from mean:

$$8 - 15.5 = 7.5$$

Determine how many standard deviations distance represents:

$$\frac{7.5}{2.5} = 3 \text{ standard deviations}$$

From the Unit Normal Distribution table in the Engineering Probability and Statistics chapter of the *FE Reference Handbook*.

$$\text{For } x = 3, R(x) = 0.0013$$

THE CORRECT ANSWER IS: A

14. Refer to the Engineering Probability and Statistics chapter of the *FE Reference Handbook*.

Binomial distribution

$$p = 0.5 \text{ (chance of getting a head)}$$

$$q = 0.5 \text{ (chance of not getting a head)}$$

$$n = 10 \text{ (number of trials)}$$

$$x = 4 \text{ (number of heads)}$$

$$\begin{aligned} P_{10}(4) &= \frac{10!}{4!6!} (0.5^4)(0.5^6) = \frac{(10)(9)(8)(7)}{(4)(3)(2)(1)} (0.5)^{10} \\ &= 0.2051 \end{aligned}$$

THE CORRECT ANSWER IS: B

15. Refer to the economic decision trees in the Engineering Economics chapter of the *FE Reference Handbook*.

$$\text{Expected value of Project B} = (0.65)(\$1,250,000) = \$812,500 \text{ (lowest payoff)}$$

$$\text{Expected value of Project A} = (0.4)(\$3,500,000) = \$1,400,000$$

$$\text{Expected value of Project C} = (0.75)(\$2,750,000) = \$2,062,500 \text{ (highest payoff)}$$

THE CORRECT ANSWERS ARE SHOWN ABOVE.

FE ELECTRICAL AND COMPUTER SOLUTIONS

16. Refer to the NCEES Rules of Professional Conduct, Section B, in the Ethics and Professional Practice chapter of the *FE Reference Handbook*.

THE CORRECT ANSWER IS: A

17. Examinees are expected to be familiar with concepts of common mode and differential mode voltages.

Point A has the highest risk. If the person is in contact with the ground, then the differential voltage applied to the person at Point A is the highest. Point B is grounded and has the lowest differential voltage. The transformer is ideal, and the load is floating. A fault condition does not exist. Thus, there is no differential voltage to ground at Point C or Point D.

THE CORRECT ANSWER IS: A

18. Refer to the NCEES Rules of Professional Conduct section in the Ethics and Professional Practice chapter of the *FE Reference Handbook*.

THE CORRECT ANSWER IS: B

19. Refer to the Ethics and Professional Practice chapter of the *FE Reference Handbook*. Section B in the Rules of Professional Conduct states:

"Licensees shall undertake assignments only when qualified by education or experience in the specific technical fields of engineering or surveying involved."

THE CORRECT ANSWER IS: C

FE ELECTRICAL AND COMPUTER SOLUTIONS

25. Refer to the Resistivity section in the Electrical and Computer Engineering chapter of the *FE Reference Handbook*.

Since the current density is 100 A/m^2 , the current in the conductor is given by:

$$I = 100 \times \text{Area} = 100 \times (\pi r^2) = 100 \times \pi(0.05)^2$$

$$I = 0.7854 \text{ A}$$

The resistance per unit length is given by:

$$R = \frac{\rho L}{A} = \frac{0.1 \Omega \cdot \text{m} \times L}{\pi(0.05 \text{ m})^2} = 12.73 \Omega/\text{m}$$

Since $P = I^2 R$, the power loss per unit length is given by:

$$P = (0.785 \text{ A})^2 \times 12.73 \Omega/\text{m} = 7.854 \text{ W/m}$$

THE CORRECT ANSWER IS: C

26. From the Solid-State Electronics and Devices section in the Electrical and Computer Engineering chapter of the *FE Reference Handbook*, the contact potential of a p-n junction is:

$$V_o = \frac{kT}{q} \ln \left(\frac{N_a N_d}{n_i^2} \right)$$

Thus, V_o is proportional to temperature in Kelvin.

From the Units and Conversion Factors chapter of the *FE Reference Handbook*:

$$^\circ\text{C} = (^\circ\text{F} - 32)/1.8$$

$$\text{K} = ^\circ\text{C} + 273.15$$

$$\text{Thus, K} = (^\circ\text{F} - 32)/1.8 + 273.15$$

$$\text{At } 80^\circ\text{F} = 299.8167 \text{ K}$$

$$\text{At } 180^\circ\text{F} = 355.3722 \text{ K}$$

$$\text{Thus, at } 180^\circ\text{F, } V_o = 0.026 \times (355.3722/299.8167) = 0.030818$$

$$\text{Increase is } 0.030818 - 0.026 = 4.8 \text{ mV}$$

THE CORRECT RANGE OF ANSWERS IS: 4.6–5.0

FE ELECTRICAL AND COMPUTER SOLUTIONS

72. Refer to the Control Systems section in the Instrumentation, Measurement, and Control chapter of the *FE Reference Handbook*.

The open-loop characteristic equation is:

$$D(s) = s^3 + 7s^2 + 14s + 8 = 0$$

$$(s + 1)(s + 2)(s + 4) = 0$$

The open-loop characteristic equation has three poles.

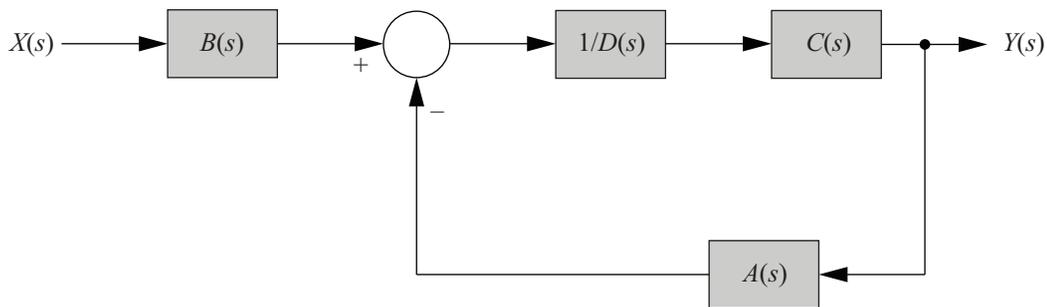
THE CORRECT ANSWER IS: D

73. Refer to the Control Systems section in the Instrumentation, Measurement, and Control chapter of the *FE Reference Handbook*.

$$\frac{Y(s)}{X(s)} = \frac{B(s)C(s)}{D(s) + A(s)C(s)} \cdot \frac{\frac{1}{D(s)}}{\frac{1}{D(s)}}$$

$$= \frac{B(s)C(s) \cdot \frac{1}{D(s)}}{1 + A(s)C(s) \cdot \frac{1}{D(s)}}$$

$$= B(s) \left[\frac{C(s) \cdot \frac{1}{D(s)}}{1 + A(s)C(s) \cdot \frac{1}{D(s)}} \right]$$



THE CORRECT LOCATIONS ARE SHOWN IN THE SHADED AREAS.