PRACTICE EXAM 17: FE ELECTRICAL AND COMPUTER SIMULATION (110 QUESTIONS)

Time allotted: 5 hours 20 minutes

Materials: NCEES-approved calculator + NCEES FE Reference Handbook only

1. What is the derivative of $f(x) = 7x^2$?

A. 7x

B. 7

C. 14x

D. $14x^2$

2. Evaluate $\int x\,dx$.

A. $x^2/2 + C$

B. $x^2 + C$

C. 1 + C

D. 2x + C

3. The product of the complex numbers j and (1 + j) is:

A. 1 + j

B. $1 - j$

C. $j - 1$

D. $-1 + j$

4. Solve for x: $x/4 = 3$.

A. 0.75

B. 12

C. 7

D. 4/3

5. Evaluate $\tan(0°)$.

A. 0

B. 1

C. ∞

D. -1

6. The derivative of $f(x) = 3\sin(x)$ is:

A. $3\sin(x)$

B. $-3\cos(x)$

C. $3\cos(x)$

D. $-3\sin(x)$

7. Evaluate $\int_1^3 2\,dx$.

A. 2

B. 4

C. 6

D. 8

8. Two vectors are orthogonal if their dot product is:

A. Equal to their magnitudes' product

B. Equal to 1

C. Maximum

D. Zero

9. The value of e^0 is:

A. 0

B. e

C. 1

D. ∞

10. The limit $\lim(x\to0) (\sin x)/x$ equals:

A. 1

B. 0

C. ∞

D. x

11. The natural logarithm ln(1) equals:

A. e

B. 1

C. 10

D. 0

12. The determinant of a 2×2 matrix with rows [5, 0] and [0, 3] is:

A. 8

B. 15

C. 0

D. 5

13. A die is rolled. What is the probability of rolling a 6?

A. 1/6

B. 1/3

C. 1/2

D. 6

14. The median of the data set 1, 3, 5, 7, 9 is:

A. 3

B. 9

C. 5

D. 25

15. If P(A) = 0.6, the probability of the complement of A is:

A. 0.6

B. 0.4

C. 1.6

D. 0.5

16. The number of combinations of 2 items chosen from 4 distinct items is:

A. 24

B. 12

C. 8

D. 6

17. A continuous random variable is uniformly distributed on [0, 4]. The probability that it falls in [0, 1] is:

A. 0.25

B. 0.5

C. 1.0

D. 0.1

18. Under the NSPE Code, an engineer's duty to protect the public is best described as:

A. The paramount obligation overriding other duties

B. Equal in weight to the duty to the employer

C. Secondary to maintaining client confidentiality

D. Applicable only on government-funded projects

19. An engineer is offered a position that would require designing a product they consider unsafe. The engineer should:

A. Accept it and quietly weaken the unsafe features

B. Accept it and document concerns only privately

C. Accept it because employment overrides safety

D. Decline to design a product they believe is unsafe

20. Under the NSPE Code, an engineer who discovers that confidential client information could prevent public harm should:

A. Sell the information to interested third parties

B. Weigh the duty to the public against confidentiality

C. Always keep the information secret regardless

D. Publish all client information immediately online

21. The NSPE Code requires that an engineer's professional conduct enhance the:

A. Honor, reputation, and usefulness of the profession

B. Engineer's personal income above all else

C. Market share of the engineer's employer

D. Speed of regulatory approval processes

22. The interest earned on $4,000 at 6% simple annual interest after 2 years is:

A. $240

B. $4,480

C. $480

D. $4,000

23. The present worth of a future amount is found by:

A. Multiplying by a compounding factor

B. Discounting it back at the interest rate

C. Adding the accumulated interest

D. Subtracting the salvage value

24. A cost incurred only when production occurs and varying with output is a:

A. Fixed cost

B. Sunk cost

C. Capital cost

D. Variable cost

25. Two projects have the same first cost; the preferred one has the:

A. Longer payback period

B. Lower net present worth

C. Higher net present worth

D. Greater total expenses

26. Compound interest differs from simple interest in that compound interest is calculated on:

A. The principal only, each period

B. A fixed annual dollar amount

C. The principal plus accumulated interest

D. The salvage value of the asset

27. A good electrical conductor is also typically a good:

A. Electrical insulator

B. Dielectric material

C. Magnetic insulator

D. Thermal conductor

28. The majority carriers in an N-type semiconductor are:

A. Holes

B. Electrons

C. Protons

D. Positive ions

29. The relative permeability of a non-magnetic material such as copper is approximately:

A. 1

B. 1000

C. 0

D. Infinite

30. Hysteresis loss in a magnetic core is caused by:

A. The resistance of the winding wire

B. Eddy currents in the conductors

C. Air gaps in the magnetic path

D. Repeated reversal of magnetic domains

31. A 24 V source drives a 4 Ω resistor. The current is:

A. 96 A

B. 0.167 A

C. 28 A

D. 6 A

32. Three resistors of 10 Ω each are connected in series. The total resistance is:

A. 3.33 Ω

B. 30 Ω

C. 10 Ω

D. 0.3 Ω

33. The power dissipated by a 4 Ω resistor carrying 5 A is:

A. 100 W

B. 20 W

C. 0.8 W

D. 80 W

34. In a parallel circuit, adding more resistors in parallel causes the total resistance to:

A. Increase

B. Stay the same

C. Become infinite

D. Decrease

35. The reactance of a 1 μF capacitor at an angular frequency of 2000 rad/s is:

A. 2000 Ω

B. 500 Ω

C. 0.002 Ω

D. 1000 Ω

36. Nodal analysis primarily applies which of Kirchhoff's laws at each node?

A. Voltage law

B. Power law

C. Current law

D. Ohm's law

37. The RMS value of a sinusoidal voltage with a peak of 100 V is approximately:

A. 70.7 V

B. 100 V

C. 141 V

D. 50 V

38. The magnitude of impedance of a series circuit with R = 3 Ω and X_L = 4 Ω is:

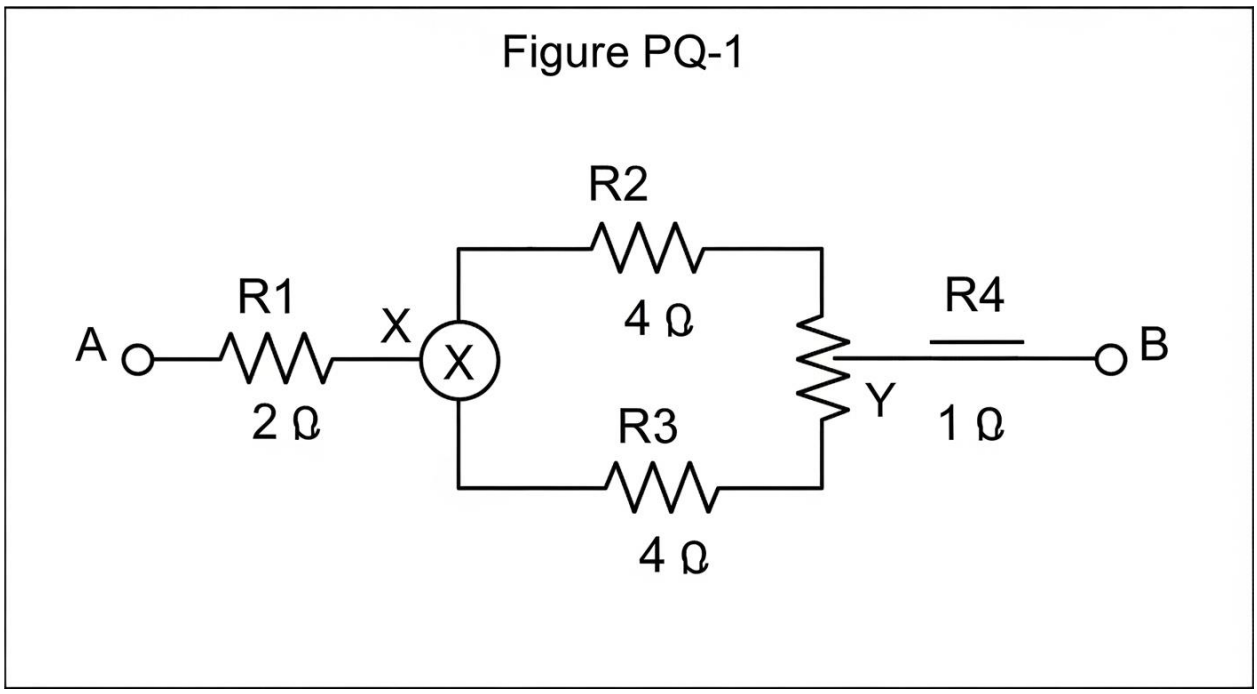
A. 1 Ω

B. 7 Ω

C. 5 Ω

D. 12 Ω

39. In the resistor network shown, what is the total resistance between terminals A and B?



A. 11 Ω

B. 7 Ω

C. 5 Ω

D. 4 Ω

40. In a purely resistive AC circuit, the power factor is:

A. Zero

B. Unity

C. 0.5

D. 0.707

41. A capacitor in a DC circuit, once fully charged, draws a steady current of:

A. Zero

B. Maximum

C. Half the source current

D. The same as a resistor

42. The voltage divider rule applies to resistors connected in:

A. Parallel only

B. A bridge configuration

C. A delta network

D. Series

43. A 12 V battery delivers 2 A for 30 minutes. The energy delivered is:

A. 24 Wh

B. 720 Wh

C. 12 Wh

D. 48 Wh

44. The Laplace transform of e^(−3t)·u(t) is:

A. $1/(s - 3)$

B. $1/(s + 3)$

C. $3/(s^2 + 9)$

D. $s/(s + 3)$

45. A system in which doubling the input doubles the output exhibits the property of:

A. Time-invariance

B. Causality

C. Memorylessness

D. Homogeneity (scaling)

46. A transfer function with a pole in the right-half s-plane represents a system that is:

A. Unstable

B. Marginally stable

C. Critically damped

D. Always stable

47. The fundamental period of the signal $x(t) = \cos(4\pi t)$ is:

A. 4 s

B. 0.5 s

C. 2 s

D. 1 s

48. The Fourier series represents a periodic signal as a sum of:

A. Decaying exponentials

B. Random noise components

C. Harmonically related sinusoids

D. A single impulse function

49. A signal band-limited to 6 kHz must be sampled at a minimum rate of:

A. 3 kHz

B. 6 kHz

C. 9 kHz

D. 12 kHz

50. The impulse response of an LTI system fully determines its:

A. Output for any arbitrary input

B. Power supply requirements

C. Physical size and weight

D. Operating temperature range

51. A band-pass filter passes frequencies:

A. Below a single cutoff only

B. Within a specific range between two cutoffs

C. Above a single cutoff only

D. Across the entire spectrum equally

52. The z-transform variable z^{-1} corresponds in the time domain to:

A. Amplification by a factor of two

B. Differentiation of the signal

C. A delay of one sample

D. A time reversal

53. Quantization in an analog-to-digital converter introduces:

A. Quantization error (noise)

B. A pure time delay

C. Aliasing distortion

D. A frequency shift

54. The DC gain of a stable transfer function H(s) is found by evaluating H(s) at:

A. $s = \infty$

B. $s = 1$

C. $s = j\omega$

D. $s = 0$

55. A system whose output is simply a scaled and delayed copy of the input is:

A. Nonlinear

B. Linear and time-invariant

C. Time-varying

D. Unstable

56. Two "golden rules" for an ideal op-amp with negative feedback are that no current flows into the inputs and that the:

A. Two input voltages are equal

B. Output is always saturated

C. Gain is exactly unity

D. Output impedance is infinite

57. A diode allows current to flow primarily in:

A. Both directions equally

B. Neither direction at all

C. One direction (forward bias)

D. The reverse direction only

58. The collector current of a BJT in the active region is approximately equal to:

A. The base current alone

B. The supply current

C. Zero at all times

D. Beta times the base current

59. The main advantage of an emitter-follower (common-collector) stage is its:

A. Low output impedance for driving loads

B. Very high voltage gain

C. 180° phase inversion

D. High output impedance

60. A reverse-biased p-n junction has a depletion region that is:

A. Filled with mobile carriers

B. The same width as at zero bias

C. Wider than at zero bias

D. Completely absent

61. The purpose of biasing a transistor amplifier is to:

A. Convert the AC signal to DC

B. Increase the supply voltage

C. Add noise to the signal

D. Set a stable DC operating point

62. An LED differs from an ordinary rectifier diode in that it is designed to:

A. Block all forward current

B. Emit light when forward biased

C. Operate only in reverse breakdown

D. Store charge like a capacitor

63. A voltage regulator using a Zener diode keeps the output voltage constant by operating the Zener in:

A. Reverse breakdown

B. Forward conduction

C. The cutoff region

D. Zero bias

64. A 100 V supply delivers 5 A to a resistive load. The power is:

A. 20 W

B. 105 W

C. 500 W

D. 95 W

65. An ideal transformer with 200 primary turns and 50 secondary turns, with 240 V on the primary, gives a secondary voltage of:

A. 960 V

B. 240 V

C. 120 V

D. 60 V

66. The rotor speed of an induction motor is always:

A. Faster than synchronous speed

B. Slower than synchronous speed

C. Exactly synchronous speed

D. Independent of the supply frequency

67. The function of a three-phase rectifier is to convert three-phase AC into:

A. DC with low ripple

B. Single-phase AC

C. Higher-frequency AC

D. A square wave output

68. A 2-pole, 60 Hz synchronous machine rotates at:

A. 1800 rpm

B. 900 rpm

C. 3600 rpm

D. 1200 rpm

69. The apparent power in an AC circuit is measured in:

A. Watts

B. Volt-amperes

C. Volt-amperes reactive

D. Joules

70. To step a voltage down from 480 V to 120 V, a transformer needs a turns ratio of:

A. 1:4

B. 2:1

C. 1:2

D. 4:1

71. The total real power consumed by three identical 1 kW single-phase loads on a three-phase system is:

A. 3 kW

B. 1.73 kW

C. 1 kW

D. 9 kW

72. A capacitor connected across an inductive motor improves the system by supplying:

A. Additional real power

B. Increased line current

C. Leading reactive power

D. Higher operating frequency

73. The unit of magnetomotive force (MMF) is the:

A. Tesla

B. Weber

C. Volt

D. Ampere-turn

74. The force between two point charges is described by:

A. Faraday's law

B. Coulomb's law

C. Ampère's law

D. Lenz's law

75. The magnetic flux through a coil is the product of the flux density and the:

A. Cross-sectional area

B. Number of turns squared

C. Resistance of the coil

D. Applied frequency

76. A wave of frequency 600 MHz has a free-space wavelength of approximately:

A. 5 m

B. 2 m

C. 1 m

D. 0.5 m

77. The error signal in a unity-feedback control system is the difference between the reference input and the:

A. Disturbance signal

B. Controller output

C. Measured output

D. Plant gain

78. A larger time constant in a first-order system results in a response that is:

A. Faster

B. Slower

C. Oscillatory

D. Unstable

79. A control system is marginally stable when its poles lie:

A. In the left-half plane

B. In the right-half plane

C. Far from the imaginary axis

D. On the imaginary axis

80. The proportional gain K_p in a controller multiplies the:

A. Error signal

B. Integral of the output

C. System time delay

D. Disturbance input

81. The percent overshoot of a second-order step response decreases as the damping ratio:

A. Decreases toward zero

B. Becomes negative

C. Increases toward one

D. Stays constant

82. The transfer function of a system is defined as the ratio of the Laplace transforms of the:

A. Input to the output

B. Output to the input

C. Feedback to the reference

D. Error to the disturbance

83. Integral control action in a PID controller primarily acts to:

A. Speed up the transient response

B. Add damping to the system

C. Amplify high-frequency noise

D. Eliminate steady-state error

84. In digital communication, the term "bit rate" refers to the number of:

A. Bits transmitted per second

B. Symbols transmitted per second

C. Carrier cycles per second

D. Errors detected per second

85. Frequency modulation encodes information by varying the carrier's:

A. Amplitude

B. Phase only

C. Frequency

D. Polarization

86. The purpose of a demodulator at a receiver is to:

A. Add the message onto a carrier

B. Recover the original message from the carrier

C. Amplify the carrier signal power

D. Combine multiple channels into one

87. According to the Shannon-Hartley theorem, channel capacity depends on bandwidth and the:

A. Signal-to-noise ratio

B. Carrier phase angle

C. Antenna polarization

D. Cable length

88. A signal with 4 bits per symbol transmitted at 1,000 symbols per second has a bit rate of:

A. 250 bps

B. 1,000 bps

C. 2,000 bps

D. 4,000 bps

89. The protocol used to retrieve email from a mail server to a client is:

A. SMTP

B. IMAP

C. ARP

D. ICMP

90. A router operates primarily at which OSI layer?

A. Physical layer

B. Data link layer

C. Network layer

D. Session layer

91. The number of bits in a standard IPv6 address is:

A. 128

B. 32

C. 64

D. 256

92. In networking, "throughput" refers to the:

A. Physical distance between two nodes

B. Number of devices on the network

C. Color of the network cabling

D. Actual rate of successful data delivery

93. Convert the decimal number 4 to binary.

A. 110

B. 100

C. 010

D. 101

94. The Boolean expression A + 0 simplifies to:

A. 1

B. 0

C. A

D. A'

95. A NAND gate is functionally equivalent to an AND gate followed by a:

A. NOT gate (inverter)

B. Second AND gate

C. OR gate

D. Buffer

96. The number of select lines required for a 4-to-1 multiplexer is:

A. 4

B. 1

C. 3

D. 2

97. Convert the binary number 1100 to decimal.

A. 6

B. 10

C. 12

D. 8

98. A flip-flop is classified as a _____ logic element.

A. Combinational

B. Sequential

C. Analog

D. Linear

99. The decimal value of the hexadecimal number 10 is:

A. 16

B. 10

C. 2

D. 8

100. The output of an XOR gate is LOW when its two inputs are:

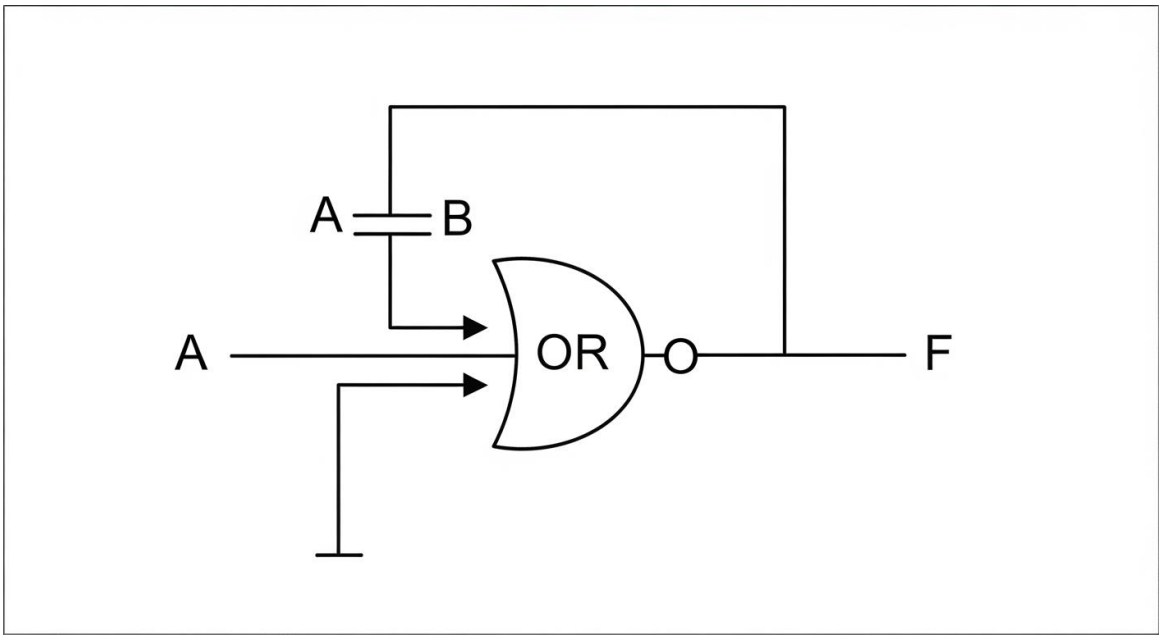
A. Both at logic 1 only

B. Both at logic 0 only

C. At different logic levels

D. At the same logic level

101. For the logic circuit shown, what is the output F when A = 1 and B = 0?



A. 0

B. 1

C. Undefined

D. High impedance

102. The "brain" of the computer that executes instructions is the:

A. Hard disk drive

B. Power supply

C. Central processing unit

D. Display monitor

103. A bit is the smallest unit of digital information and can hold a value of:

A. 0 or 1

B. 0 through 9

C. Any letter

D. Any real number

104. Compared to accessing main memory, accessing a CPU register is:

A. Much slower

B. Roughly the same speed

C. Done over the network

D. Much faster

105. The operating system component that decides which process runs next on the CPU is the:

A. Compiler

B. Device driver

C. Scheduler

D. Linker

106. A multi-core processor improves performance mainly by enabling:

A. A higher clock frequency per core

B. Parallel execution of multiple tasks

C. Larger physical memory capacity

D. Faster hard disk access times

107. In Big-O notation, accessing the first element of a linked list takes:

A. O(1) time

B. O(n) time

C. O(log n) time

D. $O(n^2)$ time

108. An "if-else" construct in programming provides:

A. Repetition of a code block

B. Permanent data storage

C. A reusable named procedure

D. Conditional branching of execution

109. A "string" data type is used to store:

A. A single true/false value

B. A sequence of text characters

C. A single whole number

D. A network connection handle

110. The purpose of a "compiler" is to:

A. Execute code line by line at runtime

B. Store the program permanently on disk

C. Translate source code into machine code

D. Connect the program to a database

PRACTICE EXAM 17 — ANSWER KEY AND FULL ANSWER EXPLANATIONS

1. C — By the power rule, $d/dx[7x^2] = 7 \cdot 2 \cdot x = 14x$. The exponent multiplies the coefficient and decreases by one.

2. A — The integral of x is $x^2/2 + C$, applying the reverse power rule. The constant of integration accounts for any vertical shift.

3. D — $j(1 + j) = j + j^2 = j - 1 = -1 + j$, since $j^2 = -1$. Multiplying distributes across the parentheses.

4. B — Multiplying both sides of $x/4 = 3$ by 4 gives $x = 12$. Clearing the denominator isolates x.

5. A — $\tan(0°) = \sin(0°)/\cos(0°) = 0/1 = 0$. The tangent of zero is zero.

6. C — The derivative of $3 \sin(x)$ is $3 \cos(x)$, since the derivative of sine is cosine. The constant factor is preserved.

7. B — $\int_1^3 2 \, dx = 2(3 - 1) = 4$, the area of a rectangle of height 2 over a width of 2. Integrating a constant gives the constant times the interval length.

8. D — Two vectors are orthogonal when their dot product is zero, since the cosine of 90° is zero. Perpendicularity removes any projection of one onto the other.

9. C — Any nonzero base raised to the zero power equals 1, so $e^0 = 1$. This is a defining property of exponents.

10. A — The standard limit $\lim(x \to 0) (\sin x)/x$ equals 1. This result underlies the derivative of the sine function.

11. D — The natural logarithm of 1 is 0, because $e^0 = 1$. The log of one is zero for any base.

12. B — For a diagonal matrix the determinant is the product of the diagonal entries: $5 \times 3 = 15$. The off-diagonal zeros contribute nothing.

13. A — A fair six-sided die has six equally likely outcomes, so $P(6) = 1/6$. Each face is equally probable.

14. C — The median of an ordered odd-length set is its middle value, which is 5 here. Half the data lie on each side.

15. B — The complement probability is $1 - P(A) = 1 - 0.6 = 0.4$. All outcomes must sum to one.

16. D — $C(4,2) = 4!/(2! \cdot 2!) = 6$. Combinations count unordered selections.

17. A — For a uniform distribution on [0, 4], the probability over [0, 1] is the length ratio 1/4 = 0.25. Probability is proportional to interval width.

18. A — The NSPE Code makes holding paramount the safety, health, and welfare of the public the engineer's first and overriding obligation. It takes precedence over duties to clients and employers.

19. D — An engineer must not design a product they believe to be unsafe, as the duty to protect the public is paramount. Declining is the ethically required response.

20. B — When confidential information bears on public safety, the engineer must balance the duty of confidentiality against the paramount duty to protect the public. Public welfare can justify disclosure through proper channels.

21. A — The NSPE Code directs engineers to conduct themselves so as to enhance the honor, reputation, and usefulness of the profession. Professional integrity sustains public trust.

22. C — Simple interest is $I = Prt = 4{,}000 \times 0.06 \times 2 = \$480$. Only the original principal earns interest.

23. B — Present worth is obtained by discounting a future amount back to today at the interest rate. Discounting reverses the effect of compounding.

24. D — A variable cost changes with the level of output and is incurred only when production occurs. It contrasts with fixed costs that remain constant.

25. C — With equal first costs, the project with the higher net present worth is economically preferred. NPW measures the value created above the required return.

26. C — Compound interest is computed on the principal plus previously accumulated interest, so interest earns interest. This produces faster growth than simple interest.

27. D — Good electrical conductors such as metals are typically good thermal conductors as well, because mobile free electrons carry both charge and heat. The same carriers transport both.

28. B — In an N-type semiconductor, donor doping makes electrons the majority carriers. Holes are the minority carriers.

29. A — A non-magnetic material such as copper has a relative permeability of about 1, nearly that of free space. It does not concentrate magnetic flux.

30. D — Hysteresis loss arises from the energy expended in repeatedly reversing the magnetic domains as the field alternates. It increases with frequency and the area of the B-H loop.

31. D — By Ohm's law, $I = V/R = 24/4 = 6$ A. Current equals voltage divided by resistance.

32. B — Series resistances add directly: $10 + 10 + 10 = 30\ \Omega$. The same current flows through each.

33. A — Power is $P = I^2R = 5^2 \times 4 = 100$ W. This form uses the known current and resistance.

34. D — Adding parallel resistors provides more paths for current, lowering the total resistance. The equivalent is always less than the smallest branch.

35. B — Capacitive reactance is $X_C = 1/(\omega C) = 1/(2000 \times 1\times10^{-6}) = 500\ \Omega$. It decreases as frequency or capacitance rises.

36. C — Nodal analysis applies Kirchhoff's current law at each node, summing currents to zero. It solves for the node voltages.

37. A — The RMS value of a sinusoid is its peak divided by $\sqrt{2}$: $100/\sqrt{2} \approx 70.7$ V. RMS gives the equivalent heating value.

38. C — Series impedance magnitude is $\sqrt{(R^2 + X^2)} = \sqrt{(3^2 + 4^2)} = \sqrt{25} = 5\ \Omega$. Resistance and reactance combine in quadrature.

39. C — The two 4 Ω resistors in parallel give 2 Ω, in series with 2 Ω and 1 Ω for a total of 5 Ω. Series and parallel combinations reduce the network step by step.

40. B — In a purely resistive AC circuit, voltage and current are in phase, giving a power factor of unity. All the apparent power is real power.

41. A — A fully charged capacitor blocks steady DC, so its current is zero in the steady state. No current flows once the voltage stops changing.

42. D — The voltage divider rule applies to resistors in series, where the source voltage splits in proportion to each resistance. The same current flows through all of them.

43. C — Energy is power times time: $P = 12 \times 2 = 24$ W over 0.5 h gives $24 \times 0.5 = 12$ Wh. The watt-hour expresses energy delivered over time.

44. B — The Laplace transform of e^(−3t)u(t) is $1/(s + 3)$. The exponential decay rate sets the pole location at $s = -3$.

45. D — Doubling the input to double the output is the homogeneity (scaling) property. Together with additivity it defines linearity.

46. A — A pole in the right-half s-plane gives a growing time response, making the system unstable. Stability requires all poles to have negative real parts.

47. B — With $\omega = 4\pi$, the period is $T = 2\pi/\omega = 2\pi/(4\pi) = 0.5$ s. The frequency is the reciprocal, 2 Hz.

48. C — A Fourier series expresses a periodic signal as a sum of harmonically related sinusoids. Each harmonic is an integer multiple of the fundamental frequency.

49. D — The Nyquist rate is twice the highest frequency: $2 \times 6 = 12$ kHz. Sampling at least this fast avoids aliasing.

50. A — The impulse response of an LTI system determines its output to any input through convolution. It fully characterizes the system.

51. B — A band-pass filter passes frequencies within a range bounded by a lower and an upper cutoff. It attenuates frequencies outside that band.

52. C — In the z-domain, multiplication by z^{-1} corresponds to a one-sample delay in the time domain. It is the discrete-time shift operator.

53. A — Quantization rounds a continuous amplitude to discrete levels, introducing quantization error, modeled as noise. Finer resolution reduces this error.

54. D — The DC gain of a stable system is H(s) evaluated at $s = 0$, corresponding to zero frequency. It gives the steady-state response to a constant input.

55. B — Scaling and delaying an input preserves both linearity and time-invariance, so the system is LTI. Such systems are fully described by their impulse response.

56. A — With negative feedback, an ideal op-amp forces its two input voltages to be equal (the virtual short) while drawing no input current. These two rules enable straightforward analysis.

57. C — A diode conducts in forward bias and blocks in reverse, allowing current essentially in one direction. This rectifying behavior comes from the p-n junction.

58. D — In the active region, the collector current is approximately β times the base current. The transistor amplifies the small base current.

59. A — The emitter-follower has near-unity voltage gain but low output impedance, making it well suited to driving loads. It buffers a high-impedance source from a low-impedance load.

60. C — Reverse bias pulls carriers away from the junction, widening the depletion region beyond its zero-bias width. The wider region supports a larger reverse voltage.

61. D — Biasing sets a stable DC operating point so the transistor amplifies the AC signal without distortion. A proper Q-point keeps the device in the active region.

62. B — An LED is designed to emit light when forward biased, as recombining carriers release photons. This distinguishes it from a rectifier diode.

63. A — A Zener regulator operates the diode in reverse breakdown, where the voltage stays nearly constant over a range of current. This clamps the output voltage.

64. C — Power for a resistive load is P = VI = 100 × 5 = 500 W. Voltage times current gives the real power.

65. D — Secondary voltage scales by the turns ratio: 240 × (50/200) = 60 V. Fewer secondary turns step the voltage down.

66. B — An induction motor's rotor always runs slower than synchronous speed; this difference is the slip that induces rotor current. Zero slip would induce no torque.

67. A — A three-phase rectifier converts three-phase AC to DC with relatively low ripple, since the phases fill in one another's gaps. This yields smoother output than single-phase rectification.

68. C — Synchronous speed is 120f/P = 120 × 60/2 = 3,600 rpm. Fewer poles give a higher speed.

69. B — Apparent power is measured in volt-amperes (VA), the product of RMS voltage and current. Real power is in watts and reactive power in VAR.

70. D — The turns ratio equals the voltage ratio: 480/120 = 4, giving 4:1. The primary has four times the turns of the secondary.

71. A — Three 1 kW loads consume 3 × 1 = 3 kW of real power total. Real powers add arithmetically regardless of the phase arrangement.

72. C — A capacitor supplies leading reactive power that offsets the inductive motor's lagging demand, improving the power factor. This reduces the reactive burden on the source.

73. D — Magnetomotive force is measured in ampere-turns, the product of current and number of turns. It is the magnetic analog of EMF.

74. B — Coulomb's law gives the force between two point charges as proportional to their product and inversely to the square of the distance. It governs electrostatic interaction.

75. A — Magnetic flux is $\Phi = B \cdot A$, the flux density times the cross-sectional area it passes through. It measures the total field through the surface.

76. D — Wavelength is $\lambda = c/f = (3\times10^{8})/(600\times10^{6}) = 0.5$ m. Higher frequencies have shorter wavelengths.

77. C — In a unity-feedback system the error is the reference input minus the measured output. The controller acts to drive this error toward zero.

78. B — A larger time constant means the system responds more slowly to changes. The output takes longer to reach its final value.

79. D — Marginal stability occurs when poles lie exactly on the imaginary axis, producing sustained oscillation. The response neither grows nor decays.

80. A — Proportional gain K_p multiplies the error signal to produce part of the controller output. A larger K_p gives a stronger corrective action.

81. C — Increasing the damping ratio toward one reduces the percent overshoot of a second-order response. Higher damping suppresses oscillation.

82. B — A transfer function is the ratio of the Laplace transform of the output to that of the input, with zero initial conditions. It characterizes the system in the s-domain.

83. D — Integral action accumulates error over time and drives the steady-state error to zero. It corrects the offset that proportional control alone leaves.

84. A — Bit rate is the number of bits transmitted per second. It differs from symbol rate, which counts symbols per second.

85. C — Frequency modulation varies the carrier's frequency in proportion to the message amplitude. The carrier amplitude stays constant.

86. B — A demodulator recovers the original message from the modulated carrier at the receiver. It reverses the modulation done at the transmitter.

87. A — The Shannon-Hartley theorem makes channel capacity depend on the bandwidth and the signal-to-noise ratio. A higher SNR allows a higher data rate.

88. D — Bit rate is bits per symbol times symbol rate: $4 \times 1{,}000 = 4{,}000$ bps. More bits per symbol raise the rate proportionally.

89. B — IMAP retrieves email from a mail server to a client while leaving messages on the server. SMTP, by contrast, sends mail.

90. C — A router operates at the network layer (Layer 3), forwarding packets based on IP addresses. It connects separate networks.

91. A — An IPv6 address is 128 bits long, far larger than IPv4's 32 bits. This vastly expands the available address space.

92. D — Throughput is the actual rate of successful data delivery over a network. It is typically lower than the nominal bandwidth.

93. B — Decimal 4 equals binary 100, since only the 2^2 place is set. Each binary place is a power of two.

94. C — A OR'd with 0 leaves A unchanged: $A + 0 = A$. Zero is the identity element for OR.

95. A — A NAND gate equals an AND gate followed by an inverter, producing the complement of the AND output. The "N" denotes the negation.

96. D — A 4-to-1 multiplexer needs 2 select lines, since $2^2 = 4$ inputs can be addressed. The select lines choose which input reaches the output.

97. C — Binary 1100 = 8 + 4 = 12 in decimal. The two high-order bits carry weights 8 and 4.

98. B — A flip-flop is a sequential element because its output depends on stored state as well as inputs. It provides one bit of memory.

99. A — Hexadecimal 10 equals decimal 16, since the leading digit carries a weight of 16^1. Hex is base 16.

100. D — An XOR output is LOW when its inputs are equal (both 0 or both 1) and HIGH when they differ. It detects difference between the inputs.

101. B — An OR gate outputs 1 when at least one input is 1, so with A = 1 and B = 0 the output F is 1. Only all-zero inputs would give 0.

102. C — The central processing unit executes program instructions and is the computer's primary processing element. It carries out arithmetic, logic, and control.

103. A — A bit is the smallest unit of digital information and holds either 0 or 1. It is the basis of all binary representation.

104. D — A CPU register is accessed much faster than main memory because it sits inside the processor. Registers are the fastest storage in the hierarchy.

105. C — The scheduler is the operating system component that selects which process runs next on the CPU. It allocates processor time among ready processes.

106. B — A multi-core processor improves performance by executing multiple tasks in parallel across its cores. True concurrency raises throughput.

107. A — Accessing the first element (head) of a linked list is O(1), a constant-time operation. No traversal is needed to reach the head.

108. D — An if-else construct provides conditional branching, choosing between code paths based on a test. It directs the flow of execution.

109. B — A string data type stores a sequence of text characters. It represents words and other textual data.

110. C — A compiler translates source code into machine code before execution. This contrasts with an interpreter, which executes code directly.