

OJEE M Tech Electrical Sample Paper 02

A) Mode and Time: The exam is a Computer Based Test (CBT) lasting 120 minutes.

B) Total Questions: The exam contains 90 questions.

C) Marking Scheme & Rules:

- +4 for correct answers and -1 for incorrect responses.

Q1. The Norton equivalent current is equal to:

- A. Short circuit current
- B. Open circuit voltage
- C. Thevenin voltage
- D. Load current

Q2. In a parallel RLC circuit, at resonance, the power factor is:

- A. Zero
- B. 0.5 lagging
- C. Unity
- D. 0.8 leading

Q3. Which of the following theorems is applicable to both linear and non-linear circuits?

- A. Superposition
- B. Thevenin
- C. Norton
- D. Tellegen's

Q4. The time constant of an RL circuit is given by:

- A. R/L
- B. L/R
- C. RL
- D. $1/RL$

Q5. In a two-port network, the Z-parameters are open-circuit parameters. Which are the short-circuit parameters?

- A. Y-parameters
- B. h-parameters
- C. ABCD-parameters
- D. g-parameters

Q6. The transfer function of a system is the Laplace transform of its:

- A. Step response
- B. Ramp response
- C. Impulse response
- D. Parabolic response

Q7. A system is marginally stable if its poles lie:

- A. In the left half plane
- B. In the right half plane
- C. On the imaginary axis
- D. At the origin only

Q8. For a type-2 system, the steady-state error for a parabolic input is:

- A. Zero
- B. Constant
- C. Infinite
- D. Negative

Q9. The phase margin of a system is measured at:

- A. Gain crossover frequency
- B. Phase crossover frequency
- C. Resonant frequency
- D. Nyquist frequency

Q10. In root locus, the number of asymptotes is equal to:

- A. $P + Z$
- B. $P - Z$

C. $Z - P$

D. $P \times Z$

Q11. The surge impedance of a typical overhead transmission line is around:

A. 50Ω

B. 400Ω

C. 1000Ω

D. 10Ω

Q12. In a power system, the penalty factor for a plant is exactly 1 when:

A. Losses are maximum

B. Losses are zero

C. It is at the load center

D. Efficiency is minimum

Q13. Which fault is the most severe in a power system?

A. L-G fault

B. L-L fault

C. L-L-G fault

D. L-L-L fault

Q14. Corona loss in a transmission line is proportional to:

A. f

B. f^2

C. $f + 25$

D. $1/f$

Q15. The positive sequence component is present in:

A. Balanced faults only

B. Unbalanced faults only

C. All types of faults

D. Ground faults only

Q16. In a transformer, the core loss is determined by:

- A. Short circuit test
- B. Open circuit test
- C. Sumpner's test
- D. Load test

Q17. A 4-pole lap wound DC generator has how many parallel paths?

- A. 2
- B. 4
- C. 8
- D. 1

Q18. The slip of an induction motor at standstill is:

- A. 0
- B. 1
- C. 0.5
- D. Infinite

Q19. V-curves of a synchronous motor show the relation between:

- A. Armature current and field current
- B. Power factor and field current
- C. Torque and speed
- D. Voltage and load

Q20. The crawling in an induction motor is caused by:

- A. Low voltage
- B. High load
- C. Harmonics
- D. Friction

Q21. An ideal operational amplifier has an input impedance of:

- A. Zero

- B. $1\text{ M}\Omega$
- C. Infinite
- D. 50Ω

Q22. A Zener diode is primarily used for:

- A. Rectification
- B. Amplification
- C. Voltage regulation
- D. Oscillation

Q23. In a BJT, the common-emitter current gain is denoted by:

- A. α
- B. β
- C. γ
- D. μ

Q24. The boolean expression $A + \bar{A}B$ simplifies to:

- A. A
- B. B
- C. $A + B$
- D. 1

Q25. How many flip-flops are required to design a Mod-10 counter?

- A. 2
- B. 3
- C. 4
- D. 5

Q26. Which ADC is the fastest?

- A. Successive Approximation
- B. Dual Slope
- C. Flash

D. Counter type

Q27. The characteristic impedance of a free space is approximately:

A. 377Ω

B. 120Ω

C. 50Ω

D. 0Ω

Q28. According to Ampere's Law, the line integral of magnetic field intensity is equal to:

A. Total charge

B. Total current enclosed

C. Voltage drop

D. Magnetic flux

Q29. The depth of penetration of a wave in a good conductor increases with:

A. Increase in frequency

B. Decrease in frequency

C. Increase in conductivity

D. Increase in permeability

Q30. A transmission line is distortionless if:

A. $R/L = G/C$

B. $RG = LC$

C. $RL = GC$

D. $R = G = 0$

Q31. A step-down chopper has an input of 100V. If duty cycle is 0.4, output voltage is:

A. 40 V

B. 60 V

C. 100 V

D. 250 V

Q32. In a thyristor, the holding current is the latching current.

- A. Greater than
- B. Equal to
- C. Less than
- D. Independent of

Q33. A single-phase full-bridge inverter requires how many switching devices?

- A. 2
- B. 4
- C. 6
- D. 8

Q34. Cycloconverters are used to convert:

- A. AC to DC
- B. DC to AC
- C. AC to AC at different frequency
- D. DC to DC

Q35. The peak inverse voltage (PIV) of a half-wave rectifier with a capacitor filter is:

- A. V_m
- B. $2V_m$
- C. $V_m/2$
- D. $V_m/\sqrt{2}$

Q36. The Laplace transform of e^{-at} is:

- A. $1/s$
- B. $1/(s - a)$
- C. $1/(s + a)$
- D. $s/(s^2 + a^2)$

Q37. An LTI system is completely described by its:

- A. Step response

- B. Impulse response
- C. Transfer function
- D. Both B and C

Q38. The z-transform of a unit impulse sequence $\delta[n]$ is:

- A. 1
- B. z
- C. $1/z$
- D. $z/(z - 1)$

Q39. Which of the following is a non-linear system?

- A. $y(t) = 2x(t)$
- B. $y(t) = x^2(t)$
- C. $y(t) = x(t - 2)$
- D. $y(t) = dx/dt$

Q40. The Fourier series of an even function contains only:

- A. Sine terms
- B. Cosine terms
- C. Odd harmonics
- D. Even harmonics

Q41. A dynamometer type wattmeter measures:

- A. True power
- B. Reactive power
- C. Apparent power
- D. Peak power

Q42. The error due to parallax in an analog meter can be reduced by using a:

- A. Mirror scale
- B. Digital display
- C. Jewel bearing

D. Magnetic shield

Q43. Megger is used for the measurement of:

- A. Low resistance
- B. High resistance
- C. Inductance
- D. Capacitance

Q44. A LVDT is an example of a:

- A. Resistive transducer
- B. Capacitive transducer
- C. Inductive transducer
- D. Piezoelectric transducer

Q45. Which bridge is used for measuring frequency?

- A. Schering bridge
- B. Wien bridge
- C. Maxwell bridge
- D. Hay bridge

Q46. The unit of solid angle is:

- A. Radian
- B. Steradian
- C. Degree
- D. Candela

Q47. For stable operation, the gain margin of a system should be:

- A. Negative
- B. Zero
- C. Positive
- D. Infinite

Q48. The highest voltage transmission line in India currently operates at:

- A. 400 kV
- B. 765 kV
- C. 1200 kV
- D. 220 kV

Q49. Bundled conductors are used in transmission lines to:

- A. Reduce inductance
- B. Increase capacitance
- C. Reduce corona loss
- D. All of the above

Q50. A synchronous condenser is a:

- A. Synchronous motor with over-excitation
- B. Synchronous generator
- C. Capacitor bank
- D. Induction motor

Q51. If the field of a DC shunt motor gets opened while running, the motor will:

- A. Stop immediately
- B. Run at dangerously high speed
- C. Run at normal speed
- D. Burn out immediately

Q52. In a 3-phase induction motor, the rotor field rotates at synchronous speed with respect to the:

- A. Rotor
- B. Stator
- C. Stator field
- D. Shaft

Q53. A transformer has maximum efficiency at 80 per cent of full load. Its iron loss is P_i and full load copper loss is P_c . The ratio P_i/P_c is:

- A. 0.8

B. 0.64

C. 1.25

D. 1.0

Q54. The boolean function $Y = AB + \bar{A}C + BC$ is equivalent to:

A. $AB + \bar{A}C$

B. $A + B + C$

C. $AB + BC$

D. $\bar{A}B + C$

Q55. A multiplexer with 8 data inputs requires how many select lines?

A. 2

B. 3

C. 4

D. 8

Q56. In an N-channel MOSFET, the majority carriers are:

A. Holes

B. Electrons

C. Both

D. None

Q57. An ideal diode acts as a:

A. Voltage source

B. Current source

C. Switch

D. Resistor

Q58. The power factor of a purely inductive circuit is:

A. Unity

B. Zero lagging

C. Zero leading

D. 0.5 lagging

Q59. The form factor of a pure sine wave is:

- A. 1.11
- B. 1.414
- C. 0.707
- D. 0.637

Q60. Which of the following plants has the lowest running cost?

- A. Thermal
- B. Nuclear
- C. Hydro
- D. Diesel

Q61. The rank of a null matrix is:

- A. 0
- B. 1
- C. -1
- D. Infinite

Q62. If A is an orthogonal matrix, then its inverse is equal to:

- A. A
- B. A^T
- C. $-A$
- D. I

Q63. The eigenvalues of an upper triangular matrix are:

- A. Zero
- B. On the main diagonal
- C. Symmetric
- D. Complex conjugates

Q64. The value of $\lim_{x \rightarrow 0} \frac{\sin x}{x}$ is:

- A. 0
- B. 1
- C. ∞
- D. Undefined

Q65. If $y = x^x$, then dy/dx is:

- A. $x^x(1 + \ln x)$
- B. $x^x \ln x$
- C. $x \cdot x^{x-1}$
- D. $x^x(1 - \ln x)$

Q66. The maximum value of $\sin x + \cos x$ is:

- A. 1
- B. 2
- C. $\sqrt{2}$
- D. 0

Q67. The differential equation $dy/dx = y/x$ represents a family of:

- A. Circles
- B. Parabolas
- C. Straight lines
- D. Hyperbolas

Q68. The integrating factor for $dy/dx + P(x)y = Q(x)$ is:

- A. $e^{\int P dx}$
- B. $e^{\int Q dx}$
- C. e^{Px}
- D. $1/P$

Q69. The Laplace transform of the unit step function $u(t)$ is:

- A. 1
- B. s

- C. $1/s$
- D. $1/s^2$

Q70. A complex function is analytic if it satisfies:

- A. Laplace equation
- B. Cauchy-Riemann equations
- C. Euler's equation
- D. Poisson's equation

Q71. The value of the contour integral $\oint (1/z)dz$ over the unit circle is:

- A. 0
- B. $2\pi i$
- C. πi
- D. 1

Q72. In a normal distribution, the curve is symmetric about the:

- A. Mean
- B. Standard deviation
- C. Variance
- D. Origin

Q73. If two dice are thrown, the probability of getting a sum of 7 is:

- A. $1/6$
- B. $1/36$
- C. $1/12$
- D. $1/2$

Q74. The probability of an impossible event is:

- A. 1
- B. 0
- C. 0.5
- D. -1

Q75. The Newton-Raphson method is used to find:

- A. Roots of equations
- B. Derivatives
- C. Integrals
- D. Eigenvalues

Q76. Trapezoidal rule evaluates the integral by approximating the curve with:

- A. Constants
- B. Straight lines
- C. Parabolas
- D. Cubics

Q77. The divergence of a curl of a vector field is always:

- A. 1
- B. The vector itself
- C. 0
- D. Gradient

Q78. The gradient of a scalar field $f(x, y, z) = x^2y$ at $(1, 1, 1)$ is:

- A. $2\hat{i} + \hat{j}$
- B. $\hat{i} + 2\hat{j}$
- C. $2\hat{i} + 2\hat{j}$
- D. 0

Q79. The trace of a square matrix is the sum of its:

- A. Rows
- B. Columns
- C. Diagonal elements
- D. Eigenvalues

Q80. Which of the following distributions has mean equal to its variance?

- A. Binomial

- B. Poisson
- C. Normal
- D. Uniform

Q81. If APPLE is coded as 1-16-16-12-5, what is the code for BAT?

- A. 2-1-20
- B. 2-1-19
- C. 3-1-20
- D. 1-2-20

Q82. Find the next number in the sequence: 2, 6, 12, 20, 30, ...

- A. 40
- B. 42
- C. 38
- D. 44

Q83. A is the brother of B. B is the sister of C. C is the father of D. How is A related to D?

- A. Uncle
- B. Brother
- C. Grandfather
- D. Cousin

Q84. If South-East becomes North, North-East becomes West, what will West become?

- A. North-East
- B. South-East
- C. South-West
- D. North-West

Q85. A train running at 72 km/hr crosses a pole in 10 seconds. What is the length of the train?

- A. 100 m
- B. 150 m

C. 200 m

D. 250 m

Q86. In a certain code, '123' means 'hot filtered coffee', '356' means 'very hot day', and '589' means 'day and night'. Which digit means 'very'?

A. 5

B. 6

C. 8

D. 9

Q87. A bag contains 5 red and 3 green apples. If one is picked at random, the probability it is red is:

A. $5/8$

B. $3/8$

C. $1/2$

D. $5/3$

Q88. Pointing to a woman, a man says, 'Her mother is the only daughter of my mother-in-law.' How is the man related to the woman?

A. Father

B. Brother

C. Husband

D. Uncle

Q89. Which word does not belong with the others?

A. Resistor

B. Capacitor

C. Inductor

D. Transistor

Q90. If 5 cats can catch 5 mice in 5 minutes, how many cats are needed to catch 100 mice in 100 minutes?

A. 5

B. 10

C. 100

D. 50

Solutions

1. A

Explanation: Norton current is the current measured when the load terminals are short-circuited.

2. C

Explanation: At resonance, the reactive components cancel out, making the circuit purely resistive.

3. D

Explanation: Tellegen's theorem is based on KCL and KVL and applies to any lumped network, linear or non-linear.

4. B

Explanation: The time constant τ for a series RL circuit is L/R .

5. A

Explanation: Y-parameters are defined by short-circuiting the ports.

6. C

Explanation: By definition, $H(s) = Y(s)/X(s)$. If input is impulse, $X(s) = 1$, so $Y(s) = H(s)$.

7. C

Explanation: Non-repeated poles on the $j\omega$ axis lead to sustained oscillations, i.e., marginal stability.

8. B

Explanation: A type-2 system has two poles at the origin, yielding a finite, non-zero steady-state error for parabolic inputs.

9. A

Explanation: Phase margin is $180^\circ + \angle G(j\omega)$ evaluated at the gain crossover frequency where $|G(j\omega)| = 1$.

10. B

Explanation: The number of branches terminating at infinity is given by the difference between the number of poles and zeros, $P - Z$.

11. B

Explanation: Overhead lines typically have higher inductance and lower capacitance, leading to a surge impedance $Z_c = \sqrt{L/C} \approx 400\Omega$.

12. C

Explanation: If a plant is at the load center, an incremental change in generation does not change transmission losses, so $L = 1$.

13. D

Explanation: A solid 3-phase (L-L-L) fault involves all phases and generally results in the highest fault current.

14. C

Explanation: According to Peek's formula, corona power loss is proportional to $(f+25)$.

15. C

Explanation: The positive sequence component represents the normal balanced operation and is present in every type of fault.

16. B

Explanation: The open-circuit test is conducted at rated voltage, so the power measured represents the core (iron) losses.

17. B

Explanation: In a simplex lap winding, the number of parallel paths A is equal to the number of poles P .

18. B

Explanation: At standstill, rotor speed $N_r = 0$, so slip $s = (N_s - N_r)/N_s = 1$.

19. A

Explanation: V-curves plot the armature current against the DC field excitation current at constant load.

20. C

Explanation: Space harmonics (specifically the 7th harmonic) cause the motor to crawl at a fraction of synchronous speed.

21. C

Explanation: An ideal op-amp draws no current at its input terminals, meaning its input impedance is infinite.

22. C

Explanation: Zener diodes operate in the breakdown region to maintain a constant voltage, acting as voltage regulators.

23. B

Explanation: The common-emitter current gain is $\beta = I_C/I_B$.

24. C

Explanation: By the distributive law, $A + \bar{A}B = (A + \bar{A})(A + B) = 1 \cdot (A + B) = A + B$.

25. C

Explanation: To count up to 10 states, we need n flip-flops such that $2^n \geq 10$. Thus, $n = 4$.

26. C

Explanation: A Flash ADC uses a parallel array of comparators, making it the fastest analog-to-digital converter.

27. A

Explanation: The intrinsic impedance of free space is $\eta_0 = \sqrt{\mu_0/\epsilon_0} \approx 120\pi \approx 377\Omega$.

28. B

Explanation: Ampere's Circuital Law states $\oint \mathbf{H} \cdot d\mathbf{l} = I_{\text{enclosed}}$.

29. B

Explanation: Skin depth $\delta = 1/\sqrt{\pi f \mu \sigma}$. It increases as frequency f decreases.

30. A

Explanation: The distortionless condition for a transmission line is $R/L = G/C$.

31. A

Explanation: For a step-down (buck) chopper, $V_0 = D \times V_{in} = 0.4 \times 100 = 40 \text{ V}$.

32. C

Explanation: Holding current is the minimum current to keep the SCR on, which is always less than the latching current.

33. B

Explanation: A single-phase full-bridge inverter consists of 4 solid-state switches (e.g., thyristors or IGBTs).

34. C

Explanation: A cycloconverter directly converts AC power at one frequency to AC power at another frequency.

35. B

Explanation: During the negative half cycle, the capacitor holds $+V_m$ while the source reaches $-V_m$, making the PIV $2V_m$.

36. C

Explanation: The standard Laplace transform of an exponential decay $e^{-at}u(t)$ is $1/(s + a)$.

37. D

Explanation: An LTI system is fully characterized by its impulse response in the time domain, or transfer function in the s-domain.

38. A

Explanation: Since $\delta[n]$ is 1 at $n = 0$ and 0 elsewhere, its z-transform is $\sum \delta[n]z^{-n} = 1 \cdot z^0 = 1$.

39. B

Explanation: The squaring operation does not satisfy the superposition principle, making it a non-linear system.

40. B

Explanation: An even function has no sine components because sine is an odd function. It contains only DC and cosine terms.

41. A

Explanation: Dynamometer wattmeters measure the average active (true) power in both AC and DC circuits.

42. A

Explanation: A mirror scale ensures the observer's line of sight is exactly perpendicular to the pointer, avoiding parallax error.

43. B

Explanation: Megger is an instrument used specifically to measure high resistances, such as insulation resistance.

44. C

Explanation: Linear Variable Differential Transformer (LVDT) works on the principle of mutual inductance.

45. B

Explanation: The Wien bridge has a balance condition that depends on the frequency of the AC source, making it suitable for frequency measurement.

46. B

Explanation: The steradian is the SI derived unit of solid angle.

47. C

Explanation: A positive gain margin indicates that the system's gain can be increased before it becomes unstable.

48. B

Explanation: India's highest operational AC transmission voltage level is 765 kV (with 1200 kV under testing/development).

49. D

Explanation: Bundling increases the effective radius, reducing the electric field gradient (less corona) and inductance, while increasing capacitance.

50. A

Explanation: An over-excited synchronous motor running without mechanical load acts like a capacitor and is used for power factor correction.

51. B

Explanation: Flux Φ becomes nearly zero. Since $N \propto 1/\Phi$, the speed will tend to infinity, running dangerously fast.

52. B

Explanation: The rotor magnetic field revolves at slip speed relative to the rotor, and at synchronous speed relative to the stationary stator.

53. B

Explanation: At max efficiency, $P_i = x^2 P_c$. Here $x = 0.8$, so $P_i/P_c = 0.8^2 = 0.64$.

54. A

Explanation: By the consensus theorem, the redundant term BC can be eliminated.
 $AB + \bar{A}C + BC = AB + \bar{A}C$.

55. B

Explanation: Since $2^n = 8$, the number of select lines n is 3.

56. B

Explanation: In an N-channel device, the channel is formed by electrons, making them the majority carriers.

57. C

Explanation: An ideal diode acts as a perfect short circuit (closed switch) when forward-biased and an open circuit when reverse-biased.

58. B

Explanation: In a purely inductive circuit, current lags voltage by 90° . Power factor $\cos(90^\circ) = 0$.

59. A

Explanation: Form factor is RMS / Average. For a sine wave, $(V_m/\sqrt{2})/(2V_m/\pi) = \pi/(2\sqrt{2}) \approx 1.11$.

60. C

Explanation: Hydroelectric plants use water as fuel, making their running/operating costs the lowest among major plant types.

61. A

Explanation: A null matrix contains only zeros, so it has no non-zero rows. Its rank is strictly 0.

62. B

Explanation: By definition, an orthogonal matrix satisfies $AA^T = I$, which implies $A^{-1} = A^T$.

63. B

Explanation: For any triangular matrix, the eigenvalues are simply the entries on its main diagonal.

64. B

Explanation: This is a fundamental limit in calculus. By L'Hopital's rule, $\lim_{x \rightarrow 0} \frac{\cos x}{1} = 1$.

65. A

Explanation: Taking natural log: $\ln y = x \ln x$. Differentiating gives $(1/y)y' = 1 \cdot \ln x + x(1/x) = 1 + \ln x$. So $y' = x^x(1 + \ln x)$.

66. C

Explanation: $\sin x + \cos x = \sqrt{2}(\frac{1}{\sqrt{2}} \sin x + \frac{1}{\sqrt{2}} \cos x) = \sqrt{2} \sin(x + \pi/4)$. The maximum is $\sqrt{2}$.

67. C

Explanation: Separating variables: $dy/y = dx/x$. Integrating gives $\ln y = \ln x + C$, which simplifies to $y = Kx$, representing straight lines through the origin.

68. A

Explanation: The standard integrating factor for a first-order linear ordinary differential equation is $e^{\int P(x)dx}$.

69. C

Explanation: The integral $\int_0^\infty 1 \cdot e^{-st} dt = [-1/se^{-st}]_0^\infty = 1/s$ for $s > 0$.

70. B

Explanation: A function is analytic if it is differentiable, which requires its real and imaginary parts to satisfy the Cauchy-Riemann equations.

71. B

Explanation: There is a simple pole at $z = 0$ with residue 1. By Cauchy's Residue Theorem, the integral is $2\pi i \times 1 = 2\pi i$.

72. A

Explanation: A Gaussian (normal) distribution is perfectly bell-shaped and symmetric around its mean value.

73. A

Explanation: There are 6 favorable outcomes (1,6; 2,5; 3,4; 4,3; 5,2; 6,1) out of 36 possible outcomes. $6/36 = 1/6$.

74. B

Explanation: An event that cannot happen has a probability of 0.

75. A

Explanation: The Newton-Raphson method is an iterative numerical technique for finding the roots of real-valued functions.

76. B

Explanation: The trapezoidal rule connects sample points with straight lines, evaluating the area as a series of trapezoids.

77. C

Explanation: A fundamental vector calculus identity states that $\nabla \cdot (\nabla \times \mathbf{A}) = 0$ for any continuous vector field $\mathbf{A}$.

78. A

Explanation: $\nabla f = \frac{\partial f}{\partial x}\hat{i} + \frac{\partial f}{\partial y}\hat{j} + \frac{\partial f}{\partial z}\hat{k} = 2xy\hat{i} + x^2\hat{j} + 0\hat{k}$. At (1,1,1), it is $2\hat{i} + \hat{j}$.

79. C

Explanation: By definition, the trace of an $n \times n$ matrix is the sum of the elements on its main diagonal.

80. B

Explanation: For a Poisson distribution with parameter λ , both the mean and the variance are equal to λ .

81. A

Explanation: The code uses the alphabetical position of each letter. B=2, A=1, T=20.

82. B

Explanation: The differences are 4, 6, 8, 10. The next difference is 12. $30 + 12 = 42$.
Alternatively, $n^2 + n$: $1^2 + 1 = 2$, $2^2 + 2 = 6$... $6^2 + 6 = 42$.

83. A

Explanation: A is the brother of C (since A, B, C are siblings). Since C is D's father, C's brother A is D's uncle.

84. B

Explanation: The compass is rotated by 135° counter-clockwise. Rotating West by 135° counter-clockwise gives South-East.

85. C

Explanation: Speed = $72 \times 5/18 = 20$ m/s. Length = Speed $\times$ Time = $20 \times 10 = 200$ meters.

86. B

Explanation: 'hot' is common in 1st/2nd statements $\Rightarrow$ '3'. 'day' is common in 2nd/3rd statements $\Rightarrow$ '5'. Thus, 'very' in the 2nd statement is '6'.

87. A

Explanation: Total apples = 8. Favorable outcomes (red) = 5. Probability = $5/8$.

88. A

Explanation: The 'only daughter of my mother-in-law' is the man's wife. Therefore, the woman's mother is the man's wife, making him the father.

89. D

Explanation: Resistors, capacitors, and inductors are passive components. A transistor is an active semiconductor component.

90. A

Explanation: 1 cat catches 1 mouse in 5 minutes. To catch 100 mice in 100 minutes (which is 20×5 minutes), each cat will catch 20 mice. $100/20 = 5$ cats are needed.