

Digital Systems and Computer Architecture: Short Answer Questions

1. What is electric current?

- The flow of electric charge, measured in amperes (A).

2. What is the SI unit of resistance?

- Ohms (Ω).

3. What does Ohm's law state?

- Ohm's law states that $V = I * R$, where V is voltage, I is current, and R is resistance.

4. What is a capacitor?

- A capacitor stores electrical energy in an electric field.

5. What is capacitance?

- Capacitance is the ability of a capacitor to store charge, measured in Farads (F).

6. What is the formula for capacitance?

- $C = Q/V$, where C is capacitance, Q is charge, and V is voltage.

7. What is an inductor?

- An inductor stores energy in a magnetic field when current flows through it.

8. What is inductance?

- Inductance is the property of an inductor that opposes changes in current, measured in Henrys (H).

9. What is a low-pass filter?

- A low-pass filter allows low-frequency signals to pass through while blocking high-frequency signals.

10. What is a high-pass filter?

- A high-pass filter allows high-frequency signals to pass through while blocking low-frequency signals.

11. What is the relationship between voltage and current in a resistor?

- Voltage is directly proportional to the current through the resistor, according to Ohms law.

12. What is the purpose of a resistor in a circuit?

- A resistor limits the flow of current and causes a voltage drop.

13. What is the role of a capacitor in an AC circuit?

- A capacitor allows alternating current (AC) to pass while blocking direct current (DC).

14. What is the formula for power in a circuit?

- $P = V * I$, where P is power, V is voltage, and I is current.

15. What is RMS voltage?

- Root Mean Square (RMS) voltage is the effective value of an AC voltage, given by $V_{RMS} = 0.707 * V_{peak}$.

16. What does the term 'frequency' mean in an AC circuit?

- Frequency is the number of cycles per second, measured in Hertz (Hz).

17. What is the symbol for a resistor in a circuit diagram?

- The symbol for a resistor is a zigzag line.

18. What is the formula for calculating resistance?

- $R = \rho * (L / A)$, where R is resistance, ρ is resistivity, L is length, and A is the cross-sectional area.

19. What is the unit of frequency?

- Hertz (Hz).

20. What is the function of an inductor in a filter circuit?

- An inductor blocks high-frequency signals and allows low-frequency signals to pass.

21. What is the purpose of a passive filter?

- A passive filter uses resistors, capacitors, and inductors to filter out unwanted frequency signals without requiring external power.

22. What is the charge of an electron?

- $-1.602 * 10^{-19}$ Coulombs.

23. What is the basic unit of charge?

- Coulomb (C).

24. What is an ideal voltage source?

- An ideal voltage source provides a constant voltage regardless of the current drawn by the load.

25. What is the role of resistors in series?

- Resistors in series add up their resistance values to increase the total resistance in the circuit.

26. What is the phase shift in an AC signal?

- Phase shift refers to the time difference between two sinusoidal signals, measured in degrees or radians.

27. What is a conductor?

- A material that allows the flow of electric current with low resistance.

28. What is the purpose of using dielectric material in capacitors?

- Dielectric material increases the capacitance by reducing the electric field between the plates of a capacitor.

29. What happens when a capacitor is fully charged in a DC circuit?

- It acts as an open circuit, blocking the flow of direct current.

30. What does the term 'impedance' mean in AC circuits?

- Impedance is the total opposition to current flow in an AC circuit, including both resistance and reactance.

Digital Systems and Computer Architecture - Questions & Answers

1. What is an electrical circuit?

- An electrical circuit is an interconnection of electrical components that forms a closed path, allowing electric charge to flow.

2. What is the SI unit of current?

- The SI unit of current is the ampere (A).

3. What is the relationship between voltage and current in Ohm's law?

- Ohm's law states that voltage (V) is directly proportional to the current (I) flowing through a resistor, $V = I * R$.

4. What does a resistor do in a circuit?

- A resistor opposes the flow of current in a circuit, causing a voltage drop.

5. What are the units used for measuring resistance?

- Resistance is measured in Ohms (Ω).

6. What is a capacitor and its basic function?

- A capacitor stores electrical energy in an electric field between its two plates and releases it when needed.

7. What is capacitance, and what is its unit?

- Capacitance is the ability of a capacitor to store charge per unit voltage, measured in Farads (F).

8. How is a capacitor charged and discharged?

- A capacitor is charged by storing energy when a voltage is applied, and it is discharged by releasing that energy when the voltage is removed.

9. What is the formula for capacitance?

- Capacitance (C) is given by $C = Q/V$, where Q is the charge stored, and V is the voltage.

10. What is an inductor and its function in a circuit?

- An inductor stores energy in a magnetic field when current flows through it and opposes changes in current.

11. What is the unit of inductance?

- The unit of inductance is the Henry (H).

12. What is a passive filter?

- A passive filter is a circuit that allows certain frequency signals to pass through while blocking others, using resistors, capacitors, and inductors.

13. What is a low-pass filter?

- A low-pass filter allows signals with frequencies below a certain cutoff frequency to pass through and attenuates higher frequencies.

14. What is a high-pass filter?

- A high-pass filter allows signals with frequencies above a certain cutoff frequency to pass through and attenuates lower frequencies.

15. What are electrolytic capacitors used for?

- Electrolytic capacitors are used for applications requiring large capacitance values, such as filtering and energy storage.

16. What is the difference between a capacitor and a resistor in a DC circuit?

- A capacitor blocks direct current (DC) after being fully charged, while a resistor allows current to flow and causes a voltage drop.

17. What is the significance of the dielectric material in a capacitor?

- The dielectric material in a capacitor increases its capacitance by reducing the electric field between the plates.

18. What happens to the current through a capacitor when the voltage across it does not change?

- When the voltage across a capacitor does not change, no current flows through the capacitor.

19. What does the term 'frequency' mean in the context of filters?

- Frequency refers to the number of cycles of a signal per second, measured in Hertz (Hz), and determines how signals are processed in filters.

20. What is the purpose of a resistor color code?

- The resistor color code is used to indicate the value of resistance and its tolerance in a color-coded format.

21. How does the resistance of a material depend on its dimensions?

- Resistance is directly proportional to the length of the material and inversely proportional to its cross-sectional area.

22. What is the significance of the phase shift in AC signals?

- Phase shift indicates the relative timing difference between two alternating signals.

23. What is the relationship between RMS voltage and peak voltage in an AC signal?

- The RMS voltage is 0.707 times the peak voltage in a sinusoidal AC signal.

24. What is the function of an inductor in a filter circuit?

- An inductor in a filter circuit blocks high-frequency signals while allowing low-frequency signals to pass.

25. What is the voltage-current relationship in an inductor?

- The voltage across an inductor is proportional to the rate of change of current through it, $V = L \frac{di}{dt}$.

26. What type of waveforms are considered sinusoidal signals?

- Sinusoidal signals are continuous, smooth waveforms that alternate between positive and negative peaks.

27. How does a capacitor behave in an AC circuit?

- In an AC circuit, a capacitor allows alternating current to pass while blocking direct current.

28. What are the key components in constructing a passive filter?

- The key components are resistors, capacitors, and inductors.

29. What does a capacitor do in a high-pass filter?

- In a high-pass filter, the capacitor allows high-frequency signals to pass through while blocking low-frequency signals.

30. What are the main types of capacitors used in electronic circuits?

- The main types of capacitors include electrolytic, ceramic, Mylar, and paper capacitors.

Digital Systems and Computer Architecture: Numerical Questions

1. (Ohm's Law) A resistor has a resistance of 10 Ω , and a current of 2 A flows through it. What is the voltage across the resistor?

$$- V = I * R = 2 * 10 = 20 \text{ V}$$

2. (Ohm's Law) What is the current flowing through a 5 Ω resistor when the voltage across it is 25 V?

$$- I = V / R = 25 / 5 = 5 \text{ A}$$

3. (Resistors in Series) Three resistors, 5 Ω , 10 Ω , and 15 Ω , are connected in series. What is the total resistance?

$$- R_{\text{total}} = 5 + 10 + 15 = 30$$

4. (Resistors in Parallel) Two resistors of 6 Ω and 3 Ω are connected in parallel. Find the total resistance.

$$- 1/R_{\text{total}} = 1/6 + 1/3 = 1/2, R_{\text{total}} = 2$$

5. (Resistors in Series) A 4 Ω resistor is connected in series with a 6 Ω resistor. If the current flowing is 2 A, what is the total voltage across the two resistors?

$$- R_{\text{total}} = 4 + 6 = 10, V = I * R_{\text{total}} = 2 * 10 = 20 \text{ V}$$

6. (Power Calculation) A device uses a 12 V battery and draws 3 A of current. What is the power consumed?

$$- P = V * I = 12 * 3 = 36 \text{ W}$$

7. (Power Calculation) A 100 W light bulb operates on 220 V. What is the current flowing through it?

$$- I = P / V = 100 / 220 = 0.45 \text{ A}$$

8. (Power Calculation) What is the power consumed by a 10 Ω resistor if the current flowing through it is 5 A?

$$- P = I^2 * R = 5^2 * 10 = 250 \text{ W}$$

9. (Capacitance) A capacitor stores 0.02 C of charge when connected to a 5 V battery. What is its capacitance?

$$- C = Q / V = 0.02 / 5 = 0.004 \text{ F}$$

10. (Capacitance) If a capacitor of 10 F is charged to a voltage of 50 V, what is the charge stored in

the capacitor?

$$- Q = C * V = 10 * 10^{-6} * 50 = 0.0005 \text{ C}$$

11. (Capacitance) What is the energy stored in a 20 F capacitor charged to 100 V?

$$- E = 1/2 * C * V^2 = 1/2 * 20 * 10^{-6} * 100^2 = 0.1 \text{ J}$$

12. (Inductance) An inductor with an inductance of 2 H has a current increasing at a rate of 3 A/s.

What is the induced voltage?

$$- V = L * dl/dt = 2 * 3 = 6 \text{ V}$$

13. (Inductance) Calculate the energy stored in a 5 H inductor with a current of 4 A.

$$- E = 1/2 * L * I^2 = 1/2 * 5 * 4^2 = 40 \text{ J}$$

14. (Inductance) A 10 mH inductor carries a current of 5 A. What is the stored energy in the inductor?

$$- E = 1/2 * L * I^2 = 1/2 * 10 * 10^{-3} * 5^2 = 0.125 \text{ J}$$

15. (AC Circuits) What is the RMS value of an AC voltage with a peak value of 100 V?

$$- V_{\text{RMS}} = 0.707 * V_{\text{peak}} = 0.707 * 100 = 70.7 \text{ V}$$

16. (AC Circuits) A sinusoidal AC voltage has a peak value of 240 V. What is its RMS value?

$$- V_{\text{RMS}} = 0.707 * 240 = 169.7 \text{ V}$$

17. (AC Circuits) If the RMS current in an AC circuit is 5 A and the resistance is 10 Ω , what is the power dissipated?

$$- P = I^2 * R = 5^2 * 10 = 250 \text{ W}$$

18. (AC Circuits) What is the peak current of an AC signal if the RMS current is 7 A?

$$- I_{\text{peak}} = I_{\text{RMS}} / 0.707 = 7 / 0.707 = 9.9 \text{ A}$$

19. (Frequency) An AC signal completes 50 cycles in 1 second. What is the frequency of the signal?

$$- f = 50 / 1 = 50 \text{ Hz}$$

20. (Frequency) What is the period of an AC signal with a frequency of 60 Hz?

$$- T = 1 / f = 1 / 60 = 0.0167 \text{ s}$$

21. (Frequency) A generator produces an AC signal with a frequency of 100 Hz. What is the time taken for one complete cycle?

$$- T = 1 / f = 1 / 100 = 0.01 \text{ s}$$

22. (Filters) A low-pass filter has a resistor of 1 k and a capacitor of 100 F. What is the cutoff frequency?

$$- f_c = 1 / (2RC) \text{ 1.59 Hz}$$

23. (Filters) A high-pass filter has a resistor of 500 and a capacitor of 10 F. What is the cutoff frequency?

$$- f_c = 1 / (2RC) \text{ 31.83 Hz}$$

24. (Impedance) What is the impedance of a 10 resistor and a 5 inductor in series at a frequency of 50 Hz? (Take $L = 0.1 \text{ H}$)

$$- Z = (R^2 + (2fL)^2)^{1/2} \text{ 32.08}$$

25. (Impedance) Calculate the impedance of a circuit with a 20 resistor and a 50 F capacitor in parallel at 60 Hz.

$$- Z \text{ 15.82}$$

26. (Induced Voltage) A magnetic field changes at a rate of 0.5 T/s across an inductor with an inductance of 0.1 H. What is the induced voltage?

$$- V = L * dB/dt = 0.1 * 0.5 = 0.05 \text{ V}$$

27. (Miscellaneous) A 10 F capacitor is discharged through a 2 M resistor. What is the time constant?

$$- \tau = R * C = 2 * 10^6 * 10 * 10^{-6} = 20 \text{ s}$$

28. (Miscellaneous) A coil with 500 turns has a magnetic flux of 0.02 Wb passing through it. What is the induced EMF if the flux changes to 0.01 Wb in 0.1 seconds?

$$- E = -N * \Delta \Phi / \Delta t = 50 \text{ V}$$

29. (Miscellaneous) A DC motor is supplied with 24 V and draws 3 A. What is its efficiency if the mechanical power output is 60 W?

$$- \eta = P_{out} / P_{in} * 100 = 83.33\%$$

30. (Miscellaneous) Calculate the voltage drop across a 200 m long copper wire with a cross-sectional area of 2 mm², resistivity $\rho = 1.68 * 10^{-8} \text{ m}$, and current of 10 A.

- V 0.0168 V