Advanced Electrical Engineering Concepts

Electrical Engineering · Answer Key · 10 Questions

1. What is the fundamental principle behind the operation of a bipolar junction transistor (BJT) that distinguishes it from a field-effect transistor (FET)?

A) The control of current is primarily achieved by an electric field applied to a gate electrode.

B) It relies on the injection of minority carriers across a forward-biased junction.

C) The input impedance is generally very high due to a gate insulator.

D) It exhibits a transconductance characteristic that is proportional to the square of the gate-source voltage.

2. In the context of power systems, what is the primary purpose of a synchronizer when connecting a generator to the grid?

A) To limit the inrush current during connection.

B) To ensure the generator's voltage, frequency, and phase angle match the grid.

C) To automatically adjust the generator's excitation for optimal power factor.

D) To provide overcurrent protection for the generator.

3. Which Maxwell's equation, in its integral form, describes the relationship between the magnetic flux through a closed surface and the absence of magnetic monopoles?

A) Gauss's Law for Electricity: ? E · dA = Q_enc / ?0

B) Faraday's Law of Induction: ? E · dl = -d?_B/dt

C) Gauss's Law for Magnetism: ? B · dA = 0

D) Ampère-Maxwell Law: ? B · dl = u0I_enc + u0?0d?_E/dt

4. In digital signal processing, what is the Nyquist-Shannon sampling theorem fundamentally concerned with?

A) The maximum amplitude of a signal that can be represented.

B) The minimum sampling rate required to perfectly reconstruct a continuous-time signal from its samples.

C) The bandwidth limitation of digital-to-analog converters.

D) The precision with which analog signals can be quantized.

5. What is the primary function of a Faraday cage?

A) To amplify electromagnetic signals.

B) To shield its interior from external static and non-static electric fields.

C) To generate high-frequency electromagnetic radiation.

D) To store electrical energy indefinitely.

6. In control systems, what does a Bode plot typically represent?

A) The step response of a system over time.
B) The root locus of a system's poles and zeros.
C) The frequency response of a system, showing gain and phase shift versus frequency.
D) The impulse response of a system.

7. What is the phenomenon described by the Hall effect?

A) The generation of a voltage difference across an electrical conductor, transverse to an electric current in the conductor and a magnetic field perpendicular to the current.
B) The emission of electrons from a heated surface.
C) The inverse piezoelectric effect.
D) The interaction between two parallel current-carrying wires.

8. Which type of electric motor is characterized by a rotating magnetic field produced by AC currents in the stator, which induces a current in the rotor, causing it to rotate?

A) DC shunt motor
B) Universal motor
C) Permanent magnet synchronous motor
D) Induction motor

9. What is the primary advantage of using a MOSFET compared to a BJT in many modern electronic circuits?

A) Higher current gain
B) Faster switching speeds at low current densities
C) Lower input impedance
D) Higher input impedance and lower power consumption for the control signal

10. In power electronics, what is the main role of a snubber circuit connected in parallel with a switching device (like a MOSFET or IGBT)?

A) To increase the switching frequency.
B) To limit the rate of voltage rise (dV/dt) across the switch during turn-off and absorb switching energy.
C) To provide a path for the load current when the switch is off.
D) To improve the power factor of the circuit.