Electronics Technician E-5 Advancement Practice Exam (Sample)

Study Guide

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Questions

1. **How are synchro systems generally classified?**
   - A. Type and Function
   - B. Torque and Control
   - C. Digital and Analog
   - D. Static and Dynamic

2. **What are non-sinusoidal oscillators generally called?**
   - A. Harmonic oscillators
   - B. Relaxation oscillators
   - C. Linear oscillators
   - D. Digital oscillators

3. **How many basic configurations may a transistor be connected in?**
   - A. Two
   - B. Four
   - C. Three
   - D. Five

4. **For maximum absorption of electromagnetic fields, where must the receiving antenna be located?**
   - A. Height of Transmission
   - B. Plane of Polarization
   - C. Correct Frequency Band
   - D. Null Point

5. **What phenomenon can occur when damping is introduced in an oscillator circuit?**
   - A. Increased gain
   - B. Decreased frequency
   - C. Reduced output amplitude
   - D. Enhanced feedback

6. What occurs when the base becomes so negative with respect to the emitter that changes in the signal are not reflected in collector-current flow?

A. Cut-off

B. Active region

C. Saturation

D. Mode-switching

7. What is the frequency range classified as HF in the electromagnetic spectrum?

A. 3 MHz to 30 MHz

B. 30 MHz to 300 MHz

C. 300 kHz to 3 MHz

D. 30 kHz to 300 kHz

8. What principle underlies many position-sensing devices such as synchros?

A. Magnetism

B. Electromagnetic Induction

C. Quantum Mechanics

D. Ohm's Law

9. Which type of feedback is critical for sustaining oscillations in an oscillator circuit?

A. Voltage feedback

B. Ground feedback

C. Positive feedback

D. Negative feedback

10. In what ways are transistors classified?

A. Dual or Single

B. NPN or PNP

C. Analog or Digital

D. Linear or Non-linear

Answers

1. B
2. B
3. C
4. B
5. C
6. C
7. A
8. B
9. C
10. B

Explanations

1. How are synchro systems generally classified?

A. Type and Function

B. Torque and Control

C. Digital and Analog

D. Static and Dynamic

Synchro systems, used primarily in navigation and control applications, are generally classified based on torque and control characteristics. This classification refers to how these systems function in terms of their ability to deliver torque (mechanical power) in relation to input signals and control mechanisms. In a typical synchro, torque is generated proportional to the differential angle between the rotor and stator windings, which affects both the performance and response of the system. Torque classification is critical for selecting the appropriate synchro for a specific application, ensuring that the system can provide the necessary torque output to drive the load or signal it is intended to control. Control classification allows users to understand the specific functionalities and applications of different synchros, such as variable speed applications or systems requiring high precision. Other classifications, such as type and function or digital and analog, provide useful information but do not capture the operational mechanics regarding torque and control as directly. Static and dynamic classifications, while relevant in some contexts, also stray from the core operational principles that govern how synchros are deployed in applications. Understanding the torque and control aspects is essential for maintaining and optimizing synchro systems in practical scenarios.

2. What are non-sinusoidal oscillators generally called?

A. Harmonic oscillators

B. Relaxation oscillators

C. Linear oscillators

D. Digital oscillators

Non-sinusoidal oscillators are primarily referred to as relaxation oscillators. This classification arises from their behavior in creating waveforms that exhibit sudden changes in voltage or current levels, followed by a slower return to an equilibrium state. Relaxation oscillators are characterized by their ability to generate a repeating waveform that is not smooth and sinusoidal in nature, such as square waves or sawtooth waves. These oscillators operate on principles of energy storage in reactive components like capacitors or inductors, accompanied by a nonlinear feedback mechanism that establishes the oscillation characteristics. The term "relaxation" reflects how the circuit returns to its initial state after being perturbed, such as through charging and discharging processes. Other options present types of oscillators that may produce sinusoidal outputs or are associated with different operational characteristics. For example, harmonic oscillators typically refer to systems that can produce pure sinusoidal signals. Linear oscillators emphasize linear responses and stability, while digital oscillators pertain to circuits that generate digital signals or pulse modulation. Hence, the designation of non-sinusoidal oscillators as relaxation oscillators is precisely aligned with their unique operational and output qualities.

3. How many basic configurations may a transistor be connected in?

A. Two

B. Four

C. Three

D. Five

Transistors can be connected in three basic configurations: common emitter, common base, and common collector. Each configuration serves a specific purpose and has distinct characteristics in terms of voltage and current amplification, input and output impedance, and phase shift. In the common emitter configuration, the input is applied between the base and emitter, while the output is taken between the collector and emitter. This setup is widely used due to its ability to provide significant voltage and current gain. The common base configuration, on the other hand, has the input connected to the emitter and the output taken from the collector. It is less commonly used but offers a very high frequency response and is often utilized in RF applications. Finally, the common collector configuration, also known as an emitter follower, has the input connected to the base and output from the emitter. This configuration does not provide voltage gain but is useful for impedance matching because it has a high input impedance and low output impedance. Understanding these three configurations helps in circuit design and analysis, as each has unique advantages suitable for particular applications.

4. For maximum absorption of electromagnetic fields, where must the receiving antenna be located?

A. Height of Transmission

B. Plane of Polarization

C. Correct Frequency Band

D. Null Point

The receiving antenna must be located at the plane of polarization for maximum absorption of electromagnetic fields because antennas are designed to operate most effectively when they are aligned with the polarized radio waves they are intended to receive. Electromagnetic waves can be polarized in different orientations—horizontal, vertical, or circular—and the orientation of the receiving antenna must match the polarization of the incoming electromagnetic field to capture the maximum signal strength. When an antenna is positioned at the correct plane of polarization, it allows for the electric field component of the wave to interact efficiently with the elements of the antenna. This results in an optimal reception, thereby enhancing signal quality and reducing losses. If the antenna is misaligned or placed outside of this plane, the effectiveness of the signal reception diminishes, leading to reduced performance in terms of gain and clarity. This understanding is crucial when designing and setting up communication systems since ensuring that antennas are positioned correctly concerning the polarization of the transmitted signals can greatly influence overall system performance.

5. What phenomenon can occur when damping is introduced in an oscillator circuit?

A. Increased gain

B. Decreased frequency

C. Reduced output amplitude

D. Enhanced feedback

When damping is introduced in an oscillator circuit, it primarily affects the output amplitude, leading to a reduced output amplitude. Damping refers to the effect of energy being lost from the oscillating system, typically due to factors such as resistance or energy loss in the components. This energy loss causes the oscillations to gradually decrease in amplitude over time, leading to a more stabilized output. In an ideal, undamped oscillator, the oscillations continue indefinitely at a steady amplitude. However, once damping is applied, the energy that would sustain those oscillations is dissipated, resulting in a gradual decline in output amplitude. This behavior is essential in many applications where stability and controlled output levels are required, as excessive oscillation can lead to undesirable effects or malfunction. Damping does not inherently change the frequency of oscillation significantly unless it is overdamped, in which case the system may not oscillate at all. Additionally, increased gain and enhanced feedback are typically associated with system alterations that are opposite to the effects of damping, which intentionally reduces the amplitude and stabilizes the output.

6. What occurs when the base becomes so negative with respect to the emitter that changes in the signal are not reflected in collector-current flow?

A. Cut-off

B. Active region

C. Saturation

D. Mode-switching

When the base of a bipolar junction transistor (BJT) becomes significantly negative relative to the emitter, the transistor enters a state known as cut-off. In this condition, the base-emitter junction becomes reverse-biased, preventing current from flowing into the base from the emitter. As a result, the transistor does not conduct; therefore, there is no collector current in response to changes in the signal. This effectively means that the transistor is turned off, and it behaves as an open switch for the purposes of signal amplification. In the cut-off region, even if the input signal attempts to produce changes in current, these changes will not affect the collector current because the required base-emitter junction conditions for conductivity are not met. Understanding this behavior is crucial for designing circuits that utilize transistors for switching and amplification in various applications. The active region refers to the operational mode where the transistor can amplify signals; saturation refers to the state of maximum current flow through the transistor, indicating it is fully on. Mode-switching would suggest transitioning between states but does not directly address the scenario presented in the question.

7. What is the frequency range classified as HF in the electromagnetic spectrum?

A. 3 MHz to 30 MHz

B. 30 MHz to 300 MHz

C. 300 kHz to 3 MHz

D. 30 kHz to 300 kHz

The frequency range classified as High Frequency (HF) in the electromagnetic spectrum is 3 MHz to 30 MHz. This designation is essential because the HF band is widely used for various communications purposes, including amateur radio, maritime communication, and aviation. The HF range is notable for its ability to support long-distance communication due to its propagation characteristics, particularly via the ionosphere. Signals in this range can reflect off the ionosphere and travel beyond the horizon, making it ideal for global communication unlike higher frequency bands which are limited by line-of-sight propagation. Understanding this frequency range is critical for electronics technicians, as it influences the design and implementation of communication systems and equipment that operate within this band.

8. What principle underlies many position-sensing devices such as synchros?

A. Magnetism

B. Electromagnetic Induction

C. Quantum Mechanics

D. Ohm's Law

Many position-sensing devices, including synchros, operate based on the principle of electromagnetic induction. This principle refers to the generation of an electromotive force (EMF) across a conductor when it is exposed to a varying magnetic field. In the case of synchros, which are commonly used in applications requiring precise positioning and direction sensing, the electromagnetic induction principles allow for the conversion of mechanical position into an electrical signal. As the rotor of a synchro turns, it alters the magnetic field within the stator windings. This change induces voltages in the stator coils, which can be used to determine the angle of the rotor. The relationship between the rotor's position and the induced voltage allows accurate position feedback to a control system. While magnetism is indeed a component of the process, it is the phenomenon of electromagnetic induction that is central to the operation of synchros, making it the most relevant principle in this context. Quantum mechanics and Ohm's Law do not directly pertain to the functional mechanics of position-sensing in synchros, as quantum effects are not typically the basis for macroscopic sensors, and Ohm's Law relates to the behavior of electrical circuits rather than position sensing.

9. Which type of feedback is critical for sustaining oscillations in an oscillator circuit?

- **A. Voltage feedback**
- **B. Ground feedback**
- **C. Positive feedback**
- **D. Negative feedback**

In an oscillator circuit, positive feedback is essential for sustaining oscillations. Oscillators rely on the principle of continuously amplifying an input signal to develop a periodic output waveform. For this amplification process to continue, the feedback from the output of the oscillator must be fed back to the input in such a way that it reinforces or enhances the original signal. When positive feedback is applied, a portion of the output signal is fed back in phase with the input signal, effectively increasing the overall gain of the circuit. This continuous reinforcement allows the output to grow until it stabilizes at a certain amplitude, producing sustained oscillations. In contrast, if negative feedback were applied, it would reduce the output signal, potentially leading to a decrease in amplitude and eventual cessation of oscillations. In summary, positive feedback is critical in oscillator circuits as it enables the necessary conditions for maintaining consistent oscillating behavior.

10. In what ways are transistors classified?

- **A. Dual or Single**
- **B. NPN or PNP**
- **C. Analog or Digital**
- **D. Linear or Non-linear**

Transistors are classified primarily based on their structure and the arrangement of their semiconductor materials. The most common classification is into NPN and PNP types. This classification indicates the configuration of the transistor: - NPN transistors have a layer of P-type material sandwiched between two N-type materials. In this configuration, current flows from the collector to the emitter when the base is supplied with a small input current, allowing for current gain. - PNP transistors, on the other hand, have a layer of N-type material between two P-type materials. Here, current flows from the emitter to the collector when a small current is applied to the base, enabling the transistor to also provide amplification. This classification based on NPN and PNP is crucial for understanding how transistors operate within circuits, particularly in switching and amplification applications. In contrast, while the options of dual or single, analog or digital, and linear or non-linear provide insight into other aspects of electronics, they do not directly address the fundamental structural categorization of transistors. Dual or single may refer to the construction of integrated circuits, analog or digital relates more to the type of signal being processed, and linear or non-linear designations pertain to the characteristics of the