Electronics & Communication

1. The property of a capacitor to store charge is measured in:

A) Henrys

B) Ohms

C) Farads

D) Watts

Answer: C) Farads

Explanation: Capacitance, measured in Farads (F), is the ratio of the change in an electric charge in a system to the corresponding change in its electric potential.

2. A thermistor is a type of resistor whose resistance is strongly dependent on:

A) Light

B) Voltage

C) Frequency

D) Temperature

Answer: D) Temperature

Explanation: Thermistors are temperature-sensitive resistors. NTC (Negative Temperature Coefficient) thermistors decrease in resistance as temperature rises, while PTC (Positive Temperature Coefficient) thermistors increase resistance with temperature.

3. Which of the following materials is commonly used to make the core of a transformer to concentrate the magnetic flux?

A) Copper

B) Aluminum

C) Soft Iron

D) Silicon

Answer: C) Soft Iron

Explanation: Soft iron is a ferromagnetic material with high magnetic permeability and low retentivity, making it ideal for creating a temporary but strong magnetic field in transformer cores.

4. A piezoelectric material generates an electric voltage in response to:

A) A change in temperature

B) Applied mechanical stress

C) A change in illumination

D) An applied magnetic field

Answer: B) Applied mechanical stress

Explanation: This is known as the piezoelectric effect, which is used in sensors, actuators, and resonators (like quartz crystals for clock generation).

5. In a p-n junction diode, the region depleted of free charge carriers near the junction is called the:

A) Depletion region

B) Intrinsic region

C) Active region

D) Forbidden region

Answer: A) Depletion region

Explanation: The depletion region (or space charge region) is formed by the diffusion of electrons and holes across the junction, creating a built-in potential barrier.

6. A Zener diode is primarily used for:

A) Amplification

B) Rectification

C) Voltage regulation

D) Oscillation

Answer: C) Voltage regulation

Explanation: Zener diodes are designed to operate in reverse breakdown. They maintain a nearly constant voltage across them despite changes in current, making them ideal for voltage reference and regulation circuits.

7. The 'beta' (β) of a Bipolar Junction Transistor (BJT) in the common-emitter configuration is the ratio of:

A) Collector current to base current (IC / IB)

B) Collector current to emitter current (IC / IE)

C) Base current to collector current (IB / IC)

D) Emitter current to base current (IE / IB)

Answer: A) Collector current to base current (IC / IB)

Explanation: Beta, or hFE, represents the DC current gain of the transistor. A high beta value means a small base current can control a much larger collector current.

8. A photodiode is a semiconductor device that converts:

A) Light into current or voltage

B) Current into light

C) Voltage into light

D) Heat into current

Answer: A) Light into current or voltage

Explanation: When photons of sufficient energy strike the photodiode, they create electron-hole pairs, generating a current that is proportional to the light intensity. It is typically operated in reverse bias.

9. According to Kirchhoff's Current Law (KCL), the algebraic sum of currents entering and leaving a node in a circuit is:

A) Equal to the supply voltage

B) Infinite

C) Always positive

D) Zero

Answer: D) Zero

Explanation: KCL is based on the principle of conservation of charge. It states that the total current flowing into a junction (or node) must be equal to the total current flowing out of it.

10. In a series RLC circuit at resonance, the impedance is:

A) Purely resistive and minimum

B) Purely capacitive

C) Purely inductive

D) Maximum

Answer: A) Purely resistive and minimum

Explanation: At the resonant frequency, the inductive reactance (XL) equals the capacitive reactance (XC). They cancel each other out, leaving only the resistance (R), resulting in the minimum possible impedance.

11. Superposition theorem is applicable only to circuits that are:

A) Nonlinear

B) Linear

C) Time-variant

D) Passive

Answer: B) Linear

Explanation: The superposition theorem states that in a linear circuit with multiple independent sources, the total response is the sum of the responses caused by each source acting alone. It does not apply to nonlinear elements.

12. The time constant (τ) of a series RC circuit is given by:

A) R/C

B) C/R

C) R x C

D) 1 / (R x C)

Answer: C) R x C

Explanation: The time constant represents the time required for the capacitor to charge to approximately 63.2% of its full charge or discharge to 36.8% of its initial voltage.

13. According to Gauss's Law for magnetism, the net magnetic flux through any closed surface is always:

A) Equal to the enclosed current

B) Proportional to the enclosed charge

C) Zero

D) Infinite

Answer: C) Zero

Explanation: This law ($\nabla \cdot B = 0$) implies that magnetic monopoles (isolated north or south poles) do not exist. Magnetic field lines always form closed loops.

14. A rectangular metal tube used to guide the propagation of high-frequency electromagnetic waves is known as a:

A) Coaxial cable

B) Stripline

C) Waveguide

D) Transmission line

Answer: C) Waveguide

Explanation: Waveguides are used primarily at microwave frequencies where transmission lines and coaxial cables would have excessive losses. They confine and direct the waves through reflection from their inner walls.

15. The intrinsic impedance of free space (η0) is approximately:

A) 50 Ω

B) 75 Ω

C) 300 Ω

D) 377 Ω

Answer: D) 377 Ω

Explanation: The intrinsic impedance of free space is the ratio of the electric field strength to the magnetic field strength of an electromagnetic wave traveling in a vacuum. Its value is $\eta_0 = \sqrt{(\mu_0/\varepsilon_0)} \approx 120\pi \approx 377$ Ohms.

16. The phenomenon by which a wave spreads out as it passes through an aperture or around an obstacle is called:

A) Reflection

B) Refraction

C) Diffraction

D) Polarization

Answer: C) Diffraction

Explanation: Diffraction is a characteristic behavior of all waves (including sound, light, and radio waves) and becomes more pronounced when the wavelength is comparable in size to the obstacle or opening.

17. An oscilloscope is an instrument that graphically displays a signal's:

A) Frequency versus time

B) Voltage versus time

C) Voltage versus frequency

D) Current versus voltage

Answer: B) Voltage versus time

Explanation: The oscilloscope is a fundamental piece of test equipment that provides a visual representation of a signal's waveform, allowing for the measurement of amplitude, period, frequency, and other characteristics.

18. A Cathode Ray Tube (CRT) uses which of the following to deflect the electron beam?

A) A focused laser beam

B) Gravitational fields

C) Electric or magnetic fields

D) Pressurized air jets

Answer: C) Electric or magnetic fields

Explanation: In a CRT, pairs of deflection plates (for electrostatic deflection) or coils (for magnetic deflection) are used to steer the electron beam horizontally and vertically to "paint" an image on the phosphorescent screen.

19. A Lissajous pattern is produced on an oscilloscope screen when:

A) The same signal is applied to both horizontal and vertical inputs

B) Two sinusoidal signals of different frequencies are applied to the horizontal and vertical inputs

C) A square wave is applied to the vertical input

D) The sweep generator is turned off

Answer: B) Two sinusoidal signals of different frequencies are applied to the horizontal and vertical inputs

Explanation: Lissajous figures are used to measure the frequency and phase relationship between two sinusoidal signals.

20. A device used to measure very low pressures, often close to a vacuum, is a:

A) Barometer

B) Manometer

C) Pirani gauge

D) Venturi meter

Answer: C) Pirani gauge

Explanation: A Pirani gauge is a type of thermal conductivity gauge that measures pressure by detecting the rate at which a heated wire filament loses heat to the surrounding gas.

21. An inverter is a power electronic circuit that converts:

A) AC to DC

B) DC to AC

C) Fixed DC to variable DC

D) Fixed AC to variable AC

Answer: B) DC to AC

Explanation: Inverters are used in applications such as uninterruptible power supplies (UPS), variable-frequency drives for AC motors, and for integrating solar panels into the AC power grid.

22. A Silicon-Controlled Rectifier (SCR) is a semiconductor device with:

A) Two terminals and three layers

B) Three terminals and four layers

C) Four terminals and three layers

D) Two terminals and four layers

Answer: B) Three terminals and four layers

Explanation: An SCR is a four-layer (P-N-P-N) thyristor with three terminals: an anode, a cathode, and a gate. It acts as a switch that can be turned on by a small pulse of current to the gate.

23. The technique of controlling the power delivered to a load by varying the on-off time of a switch is called:

A) Pulse Width Modulation (PWM)

B) Frequency Modulation (FM)

C) Amplitude Modulation (AM)

D) Phase Control

Answer: A) Pulse Width Modulation (PWM)

Explanation: PWM is highly efficient and is widely used in switch-mode power supplies, DC motor speed controllers, and Class-D audio amplifiers.

24. A 'snubber circuit' is often used in parallel with a switching device like an SCR or TRIAC to:

A) Increase the switching speed

B) Provide overvoltage protection by suppressing high dV/dt

C) Amplify the gate signal

D) Regulate the output voltage

Answer: B) Provide overvoltage protection by suppressing high dV/dt

Explanation: A snubber circuit, typically an RC network, limits the rate of rise of voltage (dV/dt) across the device when it turns off, preventing spurious triggering and protecting it from voltage spikes.

25. The gain of an ideal operational amplifier (op-amp) is:

A) Zero

B) Unity (1)

C) Finite

D) Infinite

Answer: D) Infinite

Explanation: Ideal op-amps are characterized by infinite open-loop gain, infinite input impedance, and zero output impedance. In reality, the gain is very high but finite.

26. Negative feedback in an amplifier generally leads to:

A) Increased gain and increased distortion

B) Reduced gain and increased distortion

C) Increased gain and reduced distortion

D) Reduced gain and reduced distortion

Answer: D) Reduced gain and reduced distortion

Explanation: Negative feedback sacrifices some gain to achieve significant improvements in stability, bandwidth, and linearity (reduced distortion), and to make the amplifier's performance less dependent on the transistor parameters.

27. A Schmitt trigger is a comparator circuit that exhibits:

A) Hysteresis

B) Negative resistance

C) Infinite gain

D) Zero output impedance

Answer: A) Hysteresis

Explanation: Hysteresis means the circuit has two different threshold voltages for switching—one for a rising input and one for a falling input. This makes the circuit immune to noise and prevents unwanted oscillations around the switching point.

28. An amplifier circuit configuration that provides a 180-degree phase shift between the input and output signal is the:

A) Common Collector

B) Common Base

C) Common Emitter

D) Emitter Follower

Answer: C) Common Emitter

Explanation: The common-emitter configuration is the most widely used BJT amplifier configuration because it provides both voltage and current gain, but it inherently inverts the signal.

29. Which logic gate is known as the 'universal gate' because any other logic function can be created using only this type of gate?

A) AND

B) OR

C) NOT

D) NAND

Answer: D) NAND

Explanation: Both NAND and NOR gates are universal gates. All other basic gates (AND, OR, NOT, XOR) can be constructed using a combination of only NAND gates or only NOR gates.

30. A flip-flop is a bistable multivibrator, which means it has:

A) No stable states

B) One stable state

C) Two stable states

D) Three stable states

Answer: C) Two stable states

Explanation: A flip-flop can exist indefinitely in one of two states (representing a binary 0 or 1), making it the fundamental memory element in sequential digital logic.

31. The binary equivalent of the decimal number 25 is:

A) 11001

B) 10011

C) 11010

D) 10110

Answer: A) 11001

Explanation: 16 + 8 + 0 + 0 + 1 = 25. (1 x 2^4 + 1 x 2^3 + 0 x 2^2 + 0 x 2^1 + 1 x 2^0).

32. A multiplexer (MUX) is a digital circuit that:

A) Selects one of several analog input signals and forwards it to a single output

B) Selects one of several digital input signals and forwards it to a single output

C) Distributes a single input signal to one of several outputs

D) Performs arithmetic operations on multiple inputs

Answer: B) Selects one of several digital input signals and forwards it to a single output

Explanation: A multiplexer acts like a digitally controlled switch. The input to be selected is determined by the binary code applied to its 'select' lines.

33. The transfer function of a system is defined as the Laplace transform of the output divided by the Laplace transform of the input, assuming:

A) Zero initial conditions

B) Non-zero initial conditions

C) The system is unstable

D) The input is a step function

Answer: A) Zero initial conditions

Explanation: The transfer function characterizes the dynamic behavior of the system itself, independent of the initial state.

34. A system is considered stable if its output for any bounded input is:

A) Always unbounded

B) Always bounded

C) Oscillatory

D) Zero

Answer: B) Always bounded

Explanation: This is the definition of Bounded-Input, Bounded-Output (BIBO) stability. A stable system will not have an output that grows indefinitely in response to a finite input.

35. The Bode plot is a graph used in control system engineering to analyze the:

A) Time response of a system

B) Root locus of a system

C) Frequency response of a system

D) Stability margin in the s-plane

Answer: C) Frequency response of a system

Explanation: A Bode plot consists of two graphs: one plotting the magnitude (in decibels) of the frequency response versus frequency, and the other plotting the phase shift versus frequency.

36. The part of a control system that measures the output and sends a signal back to the controller for comparison with the input is the:

A) Actuator

B) Plant

C) Sensor

D) Error detector

Answer: C) Sensor

Explanation: The sensor (or transducer) provides the feedback that is essential for a closed-loop control system to operate, allowing it to correct for errors.

37. The process of impressing a low-frequency information signal onto a high-frequency carrier wave is known as:

A) Demodulation

B) Multiplexing

C) Modulation

D) Detection

Answer: C) Modulation

Explanation: Modulation is necessary to transmit low-frequency signals over long distances efficiently using antennas of a practical size.

38. In Frequency Modulation (FM), the information is encoded by varying the:

A) Amplitude of the carrier wave

B) Frequency of the carrier wave

C) Phase of the carrier wave

D) Pulse width of the carrier wave

Answer: B) Frequency of the carrier wave

Explanation: The amplitude of the FM carrier remains constant, while its frequency deviates above and below its center value in proportion to the amplitude of the message signal. This makes FM more robust against noise than AM.

39. Time Division Multiplexing (TDM) is a technique used to:

A) Transmit multiple signals over a single channel by dividing the frequency spectrum

B) Transmit multiple signals over a single channel by allotting each signal a different time slot

C) Encode data using different time delays

D) Modulate a carrier wave using time intervals

Answer: B) Transmit multiple signals over a single channel by allotting each signal a different time slot

Explanation: TDM is widely used in digital telephony (e.g., T1 lines) and other digital communication systems.

40. According to the Nyquist theorem, to avoid aliasing, the sampling frequency for an analog signal must be:

A) Equal to the highest frequency in the signal

B) Less than the highest frequency in the signal

C) At least twice the highest frequency in the signal

D) Half the highest frequency in the signal

Answer: C) At least twice the highest frequency in the signal

Explanation: This minimum sampling rate, known as the Nyquist rate, is a fundamental principle of digital signal processing that ensures the original analog signal can be perfectly reconstructed from its samples.

41. The main advantage of a superheterodyne receiver over earlier designs (like TRF) is its:

A) Simplicity and low cost

B) Superior selectivity and sensitivity

C) Smaller size and weight

D) Ability to receive only AM signals

Answer: B) Superior selectivity and sensitivity

Explanation: By converting all incoming frequencies to a fixed intermediate frequency (IF), the amplification and filtering can be highly optimized, leading to consistent performance across the entire tuning range.

42. In an AM receiver, the circuit that extracts the original audio information from the modulated carrier wave is called the:

A) Mixer

B) IF Amplifier

C) Detector

D) Local Oscillator

Answer: C) Detector

Explanation: The detector, also known as the demodulator, is typically a simple circuit like an envelope detector (using a diode and a capacitor) for AM signals.

43. The fidelity of a radio receiver refers to its ability to:

A) Reject unwanted signals

B) Pick up weak signals

C) Accurately reproduce the original modulation signal without distortion

D) Maintain a stable tuning frequency

Answer: C) Accurately reproduce the original modulation signal without distortion

Explanation: High fidelity means the audio output sounds exactly like the original broadcast, with a flat frequency response over the entire audio range.

44. The local oscillator in a superheterodyne receiver always operates at a frequency that is:

A) The same as the incoming signal frequency

B) Either higher or lower than the incoming signal frequency by a fixed amount (the IF)

C) Twice the incoming signal frequency

D) Half the incoming signal frequency

Answer: B) Either higher or lower than the incoming signal frequency by a fixed amount (the IF)

Explanation: The mixer combines the local oscillator signal with the incoming RF signal to produce the fixed intermediate frequency ($f_{IF} = |f_{LO} - f_{RF}|$).

45. A Traveling Wave Tube (TWT) is best described as a:

A) Low-power microwave oscillator

B) High-power, wide-bandwidth microwave amplifier

C) Microwave frequency mixer

D) Solid-state microwave switch

Answer: B) High-power, wide-bandwidth microwave amplifier

Explanation: A TWT uses a helical structure to slow down the RF wave so that it can interact continuously with an electron beam, providing very high gain over a broad range of frequencies. It is commonly used in satellite transponders.

46. An isolator is a two-port microwave device that:

A) Allows signals to pass in both directions with equal attenuation

B) Allows signals to pass in one direction with very low attenuation and blocks them in the reverse direction

C) Splits power equally between two output ports

D) Combines power from two input ports

Answer: B) Allows signals to pass in one direction with very low attenuation and blocks them in the reverse direction

Explanation: Isolators are used to protect microwave sources (like oscillators and amplifiers) from reflections that could cause instability or damage.

47. Radar systems use microwave pulses primarily because:

A) Microwaves are not affected by weather

B) Microwaves travel faster than other radio waves

C) They provide good directional resolution with reasonably sized antennas

D) They are cheaper to generate than lower frequency waves

Answer: C) They provide good directional resolution with reasonably sized antennas

Explanation: The short wavelength of microwaves allows for the creation of very narrow, focused beams, which is essential for determining the precise direction and location of a target.

48. A Gunn diode is a solid-state device used for:

A) High-power amplification

B) Generating low-power microwave signals

C) Rectifying microwave signals

D) Voltage regulation

Answer: B) Generating low-power microwave signals

Explanation: The Gunn diode exhibits a negative resistance effect and is used in simple, low-cost microwave oscillators for applications like police radar guns and door openers.

49. A satellite that appears to remain stationary in the sky as viewed from the Earth is in a:

A) Low Earth Orbit (LEO)

B) Polar Orbit

C) Geostationary Orbit (GEO)

D) Molniya Orbit

Answer: C) Geostationary Orbit (GEO)

Explanation: A GEO satellite orbits the Earth above the equator at an altitude of approximately 35,786 km (22,236 miles) with an orbital period of exactly 24 hours, matching the Earth's rotation. This allows ground station antennas to be pointed at a fixed position.

50. The delay between transmitting a signal to a geostationary satellite and receiving it back on Earth is approximately:

A) 25 milliseconds

B) 250 milliseconds

C) 1 second

D) 5 seconds

Answer: B) 250 milliseconds

Explanation: The signal must travel up to the satellite and back down, a round trip of over 70,000 km. This significant propagation delay (latency) is a key characteristic of GEO satellite communication.

51. The typical frequency band used for the downlink in C-band satellite communication is:

A) 6 GHz

B) 4 GHz

C) 14 GHz

D) 11 GHz

Answer: B) 4 GHz

Explanation: In the C-band, the uplink is typically around 6 GHz and the downlink is around 4 GHz. The lower frequency is used for the downlink because it is less susceptible to rain fade.

52. The Global Positioning System (GPS) is based on a constellation of satellites in:

A) Low Earth Orbit (LEO)

B) Geostationary Orbit (GEO)

C) Medium Earth Orbit (MEO)

D) Highly Elliptical Orbit (HEO)

Answer: C) Medium Earth Orbit (MEO)

Explanation: The GPS constellation consists of numerous satellites orbiting at an altitude of about 20,200 km, ensuring that at least four satellites are visible from any point on Earth at any time.

53. The part of the CPU that performs arithmetic operations (like addition, subtraction) and logic operations (like AND, OR, NOT) is the:

A) Control Unit

B) Arithmetic Logic Unit (ALU)

C) Register Array

D) Memory Management Unit

Answer: B) Arithmetic Logic Unit (ALU)

Explanation: The ALU is the fundamental execution core of a microprocessor.

54. In microprocessor terminology, an 'interrupt' is a signal that:

A) Causes the processor to halt and shut down

B) Indicates an error in the program code

C) Temporarily suspends the currently running program to execute a special service routine

D) Speeds up the execution of the current instruction

Answer: C) Temporarily suspends the currently running program to execute a special service routine

Explanation: Interrupts are used by I/O devices to get the processor's attention when they need service (e.g., a key has been pressed on the keyboard), allowing for efficient multitasking.

55. The clock speed of a microprocessor, measured in Hertz (e.g., MHz or GHz), determines the:

A) Amount of memory it can address

B) Number of instructions it can execute per second

C) Number of I/O ports available

D) Physical size of the processor

Answer: B) Number of instructions it can execute per second

Explanation: The clock signal synchronizes the internal operations of the CPU. A higher clock speed generally means the processor can perform more operations in a given amount of time.

56. A memory that loses its contents when the power is turned off is called:

A) Non-volatile memory

B) Volatile memory

C) Read-only memory (ROM)

D) Flash memory

Answer: B) Volatile memory

Explanation: Random Access Memory (RAM), including both SRAM and DRAM, is volatile. ROM, EEPROM, and Flash are examples of non-volatile memory.

57. The Fourier Transform is a mathematical tool that decomposes a signal in the time domain into its constituent:

A) Amplitudes in the voltage domain

B) Frequencies in the frequency domain

C) Phases in the phase domain

D) Samples in the discrete domain

Answer: B) Frequencies in the frequency domain

Explanation: The Fourier Transform is fundamental to signal processing, allowing engineers to analyze the frequency content (spectrum) of a signal.

58. A signal that is deterministic is one whose:

A) Future values can be predicted exactly from its past values

B) Behavior is completely random

C) Amplitude is always constant

D) Frequency is always changing

Answer: A) Future values can be predicted exactly from its past values

Explanation: A deterministic signal can be described by a mathematical formula, such as $x(t) = \sin(\omega t)$. In contrast, a random signal like noise cannot be predicted.

59. The impulse response of a system, denoted h(t), is the output of the system when the input is:

A) A step function

B) A sinusoidal function

C) A Dirac delta (impulse) function

D) Zero

Answer: C) A Dirac delta (impulse) function

Explanation: The impulse response completely characterizes a linear time-invariant (LTI) system. Knowing h(t) allows you to find the output for any arbitrary input using convolution.

60. A signal x(t) is said to be an even signal if it satisfies the condition:

A) $x(t) = x(-t)$

B) $x(t) = -x(-t)$

C) $x(t) = x(t + T)$ for some period T

D) $x(t) = 0$ for $t < 0$

Answer: A) $x(t) = x(-t)$

Explanation: An even signal is symmetric about the vertical axis (t=0). An example is the cosine function. A signal where $x(t) = -x(-t)$ is an odd signal, like the sine function.