

SIDDHARTHA INSTITUTE OF TECHNOLOGY & SCIENCES

CONTENTS

S. No	Description	Page No.
1	Vision & Mission of the Institute	
2	Vision & Mission of the Department	
3	Program Outcomes	
4	Rules and Regulations of Lab	
5	Understand the significance of electronics and communications subjects	
6	Identify the different passive and active components	
7	Color code of resistors, finding the types and values of capacitors	
8	Measure the voltage and current using voltmeter and ammeter	
9	Measure the voltage, current with Multimeter and study the other measurements using Multimeter	
10	Study the CRO and measure the frequency and phase of given signal	
11	Draw the various Lissajous figures using CRO	
12	Study the function generator for various signal generations	
13	Study of Spectrum analyzer and measure the spectrum	
14	Operate Regulated power supply for different supply voltages	
15	Study the various gates module and write down the truth table of them	

16	Identify various Digital and Analog ICs	
17	Observe the various types of modulated signals	
18	Know the available Softwares for Electronics and communication applications	

SIDDHARTHA INSTITUTE OF TECHNOLOGY & SCIENCES

VISION & MISSION OF THE INSTITUTE

VISION:

To be a Centre of Excellence in Technical Education and to become an epic center of Research for creative solutions.

MISSION:

To address the Emerging Needs through Quality Technical Education with an emphasis on practical skills and Advanced Research with social relevance.

OBJECTIVES:

- To translate our vision into action and accomplish our mission, we strive to provide state-of-art infrastructure.
- Recruit, Motivate and develop faculty of high caliber and with multiple specialization.
- Continuously review, innovate and experiment teaching methodologies and learning processes.
- Focus on research, training and consultancy through an Integrated Institute-Industry symbiosis.

SIDDHARTHA INSTITUTE OF TECHNOLOGY & SCIENCES

VISION & MISSION OF THE DEPARTMENT

VISION :

To provide innovative teaching and learning methodologies for excelling in a high-value career, higher education and research to the students in the field of Electronics and Communication Engineering to meet the needs of the industry and to be a part of the advancing technological revolution.

MISSION :

- To create engineers of high quality on par with international standards by providing excellent infrastructure and well qualified faculty.
- To establish centers of excellence to enhance collaborative and multidisciplinary activities to develop human and intellectual qualities.
- To provide technical expertise to carry out research and development.

PROGRAM EDUCATIONAL OBJECTIVES (PEOS) :

Graduates shall apply the fundamental, advanced and contemporary knowledge of

1. Electronics, Communication and allied Engineering, to develop efficient solutions and systems, to meet the needs of the industries and society.
2. Graduates will get employed or pursue higher studies or research.
3. Graduates will have team spirit, good communication skills and ethics with lifelong learning attitude.

SIDDHARTHA INSTITUTE OF TECHNOLOGY & SCIENCES

PROGRAM OUTCOMES:

Engineering Graduates will be able to:

1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

RULES AND REGULATIONS OF LAB

All students must observe the Dress Code while in the laboratory.

- ✚ All bags must be placed at rack.
- ✚ The lab timetable must be strictly followed.
- ✚ Be PUNCTUAL for your laboratory session.
- ✚ Program/experiment must be executed within the given time.
- ✚ Workspace must be kept clean and tidy at all time.

- ✚ Handle the systems and interfacing kits with care.
- ✚ All students are liable for any damage to the accessories due to their own negligence.
All interfacing kits connecting cables must be RETURNED if you taken from the lab supervisor.
- ✚ Students are strictly PROHIBITED from taking out any items from the laboratory.
- ✚ Students are NOT allowed to work alone in the laboratory without the Lab Supervisor
- ✚ Supervisor USB Ports have been disabled if you want to use USB drive consult lab supervisor.
- ✚ Report immediately to the Lab Supervisor if any malfunction of the accessories, is there

Before leaving the lab

- ✚ Place the chairs properly.
- ✚ Turn off the system properly
- ✚ Turn off the monitor.
- ✚ Please check the laboratory notice board regularly for updates.

1. UNDERSTAND THE SIGNIFICANCE OF ELECTRONICS AND COMMUNICATIONS SUBJECTS

Electronics and Communications are two closely related fields that play a critical role in shaping the modern world. These subjects have significant importance in various aspects of our lives, ranging from personal communication devices to complex industrial systems. Here's an overview of their significance:

Electronics:

1. **Technology Advancement:** Electronics is the foundation of modern technology. It has led to the development of devices like smart phones, computers, medical equipment, and more, which have revolutionized the way we live and work.
2. **Miniaturization:** The field of electronics has continuously pushed the limits of miniaturization, leading to smaller and more powerful devices. This has enabled the creation of portable gadgets with advanced capabilities.
3. **Automation and Robotics:** Electronics is essential for developing control systems, sensors, and actuators that drive automation and robotics. These technologies are used in manufacturing, healthcare, transportation, and various industries.
4. **Renewable Energy:** Electronics plays a key role in harnessing and converting renewable energy sources such as solar, wind, and hydroelectric power into usable electricity.
5. **Medical Diagnostics and Treatment:** Medical devices, from MRI machines to pacemakers, rely on electronics for accurate diagnosis and treatment. Advanced electronics also enable telemedicine and remote patient monitoring.
6. **Consumer Electronics:** Electronics is behind the creation of entertainment systems, gaming consoles, wearable devices, and smart home technologies, enhancing our daily lives.

Communications:

1. **Global Connectivity:** Communication technologies like the internet, satellites, and wireless networks have connected the world like never before. They enable instant global communication, information sharing, and collaboration.
2. **Economic Growth:** A strong communication infrastructure is essential for economic growth. It facilitates trade, e-commerce, and financial transactions on a global scale.
3. **Social Interaction:** Communication tools such as social media platforms and messaging apps have transformed the way people interact, share information, and build relationships.

4. **Emergency Services:** Communications are critical for emergency response and disaster management. Quick and efficient communication systems can save lives during natural disasters and crises.
5. **Mass Media:** Broadcasting and telecommunications play a crucial role in spreading news, entertainment, and information to a wide audience, shaping public opinion and culture.
6. **Remote Work and Learning:** Recent trends have highlighted the importance of communications in enabling remote work, online education, and virtual collaboration, especially during challenging times like the COVID pandemic.

Overall, the significance of electronics and communications cannot be overstated. They drive innovation, influence various industries, enhance our quality of life, and contribute to the global economy. As technology continues to advance, these fields will likely play an even more significant role in shaping the future.

2. IDENTIFY THE DIFFERENT PASSIVE AND ACTIVE COMPONENTS

Electronics components can be broadly categorized into two main types: passive components and active components. These components serve different functions within electronic circuits and systems. Here's an overview of both types:

Passive Components: Passive components do not amplify or control electrical signals; rather, they respond to or store energy. They are used to build the foundational elements of electronic circuits and perform functions like filtering, coupling, and impedance matching. Some common passive components include:

1. **Resistor:** A resistor limits the flow of current in a circuit and is used to control voltage levels and currents. It's often represented by the symbol "R" and is measured in ohms (Ω).
2. **Capacitor:** A capacitor stores and releases electrical energy in the form of an electric field between its plates. It's used for energy storage, coupling signals, and filtering. Its symbol is "C," and its unit is the farad (F).
3. **Inductor:** An inductor stores energy in the form of a magnetic field when current flows through it. It's used in applications like energy storage, filtering, and impedance matching. Its symbol is "L," and its unit is the henry (H).
4. **Diode:** A diode allows current to flow in one direction only. It's used for rectification, signal demodulation, and voltage regulation. The symbol for a diode varies based on its type.
5. **Transformer:** A transformer consists of two or more coils of wire and is used to transfer electrical energy between them via electromagnetic induction. It's commonly used for voltage conversion and isolation.
6. **Resonator:** Resonators are used to create or respond to specific frequency resonances in circuits. They're important in applications like tuning oscillators and filters.




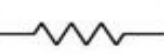








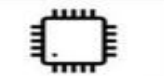







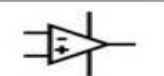


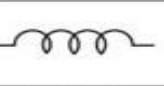
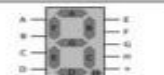


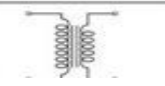
Active Components: Active components are capable of controlling the flow of electrical current and can amplify, rectify, or generate signals. They require an external power source to operate and are crucial for signal processing and amplification. Some common active components include:

1. **Transistor:** Transistors are semiconductor devices that can amplify or switch electronic signals and control the flow of current. They come in various types, such as bipolar junction transistors (BJTs) and field-effect transistors (FETs).
2. **Operational Amplifier (Op-Amp):** An op-amp is a versatile integrated circuit that amplifies the difference between two input voltages. It's widely used in amplification and signal processing circuits.

3. **Integrated Circuits (ICs):** ICs are miniaturized electronic circuits that can contain a variety of active and passive components. They can perform complex functions such as microprocessors, memory storage, and communication.
4. **Triode Vacuum Tube:** Although less common today, vacuum tubes were once widely used for signal amplification and switching in early electronic devices.
5. **Thyristor:** A thyristor is a semiconductor device used for switching and controlling electrical signals in power electronics applications.
6. **Field-Effect Transistor (FET):** A FET is a type of transistor that relies on an electric field to control the flow of current. It's used in amplification and switching applications.

These are just a few examples of passive and active components in electronics. The combination of these components allows engineers and designers to create a wide range of electronic devices and systems with varying levels of complexity and functionality..

Active and Passive Components

Active Components			Passive Components		
Transistor			Resistor		
Diode			Variable Resistor		
Photodiode			LDR		
Integrated Circuit			Thermistor		
LED			Capacitor		
Operational Amplifier			Inductor		
Seven Segment Display			Transformer		

3. COLOR CODE OF RESISTORS, FINDING THE TYPES AND VALUES OF CAPACITORS

Resistors are often marked with color bands that indicate their resistance value, tolerance, and sometimes temperature coefficient. The color code consists of several bands, each representing a different parameter. Here's how to interpret the color code:

1. **First Band (Significant Figure):** This band represents the first digit of the resistance value. Each color corresponds to a specific digit, ranging from 0 to 9.
2. **Second Band (Significant Figure):** This band represents the second digit of the resistance value.
3. **Third Band (Multiplier):** This band indicates the multiplier by which the significant figures should be multiplied. It determines the order of magnitude. Each color corresponds to a power of 10.
4. **Fourth Band (Tolerance):** The fourth band indicates the tolerance level of the resistor, which represents the allowed deviation from the specified resistance value. It's usually expressed as a percentage.
5. **Fifth Band (Optional - Temperature Coefficient):** Some precision resistors have a fifth band that indicates the temperature coefficient of the resistor. This value indicates how the resistance changes with temperature.

Here are the color codes for the significant figures, multiplier, and tolerance:

- **Significant Figures:** Black (0), Brown (1), Red (2), Orange (3), Yellow (4), Green (5), Blue (6), Violet (7), Gray (8), White (9).
- **Multiplier:** Black ($\times 1$), Brown ($\times 10$), Red ($\times 100$), Orange ($\times 1,000$), Yellow ($\times 10,000$), Green ($\times 100,000$), Blue ($\times 1,000,000$), Gold ($\times 0.1$), Silver ($\times 0.01$).
- **Tolerance:** Brown ($\pm 1\%$), Red ($\pm 2\%$), Green ($\pm 0.5\%$), Blue ($\pm 0.25\%$), Violet ($\pm 0.1\%$), Gray ($\pm 0.05\%$), Gold ($\pm 5\%$), Silver ($\pm 10\%$).

Types and Values of Capacitors: Capacitors are marked with various labeling systems depending on their type and manufacturer. Common capacitor types include ceramic, electrolytic, tantalum, and film capacitors. The markings typically indicate the capacitance value, voltage rating, and sometimes tolerance.

1. **Ceramic Capacitors:** These often use alphanumeric codes to indicate their capacitance value and tolerance. For example, a code like "104" on a ceramic capacitor corresponds to 10×10^4 pF = 100,000 pF = 100 nF.

2. **Electrolytic Capacitors:** These capacitors are often marked with their capacitance value and voltage rating. For instance, a marking like "220 μ F 25V" indicates a capacitance of 220 microfarads and a voltage rating of 25 volts.
3. **Tantalum Capacitors:** Tantalum capacitors typically use a three-digit code to indicate capacitance in picofarads and voltage rating. The first two digits represent significant figures, and the third digit represents the multiplier. For example, "104" on a tantalum capacitor means $10 \times 10^4 \text{ pF} = 100,000 \text{ pF} = 100 \mu\text{F}$.
4. **Film Capacitors:** These capacitors usually have their capacitance and voltage rating printed directly on them, similar to electrolytic capacitors.

It's important to consult the manufacturer's datasheets or guidelines to accurately interpret the markings on capacitors and resistors, as different manufacturers might use slightly different systems.

4. MEASURE THE VOLTAGE AND CURRENT USING VOLTMETER AND AMMETER

Measuring Voltage Using a Voltmeter: A voltmeter measures the potential difference (voltage) between two points in a circuit. Here's how to measure voltage using a voltmeter:

1. **Turn off Power:** Ensure that the circuit is turned off to prevent any accidents or damage while making connections.
2. **Select Voltage Range:** Set the voltmeter to a voltage range that is appropriate for the expected voltage in the circuit. Choose a range higher than the expected voltage.
3. **Connect Voltmeter:** Connect the voltmeter in parallel across the two points between which you want to measure the voltage. The positive (red) lead of the voltmeter goes to the point with higher potential, and the negative (black) lead goes to the point with lower potential.
4. **Turn on Power:** Once the voltmeter is correctly connected, you can turn on the power to the circuit.
5. **Read Voltage:** The voltmeter will display the voltage between the two selected points in the circuit.

Measuring Current Using an Ammeter: An ammeter measures the current flowing through a circuit. Here's how to measure current using an ammeter:

1. **Turn off Power:** Make sure the circuit is turned off before making any connections.
2. **Select Ammeter Range:** Choose the appropriate current range on the ammeter based on the expected current in the circuit. Make sure the selected range can handle the anticipated current without overloading the ammeter.
3. **Open Circuit:** Identify the point in the circuit where you want to measure the current. Open the circuit at this point to insert the ammeter.
4. **Connect Ammeter:** Connect the ammeter in series with the circuit. The ammeter's positive (red) lead goes to the side of the open circuit where the current enters, and the negative (black) lead goes to the side where the current exits.
5. **Close Circuit and Turn on Power:** After the ammeter is properly connected, close the circuit and turn on the power.
6. **Read Current:** The ammeter will display the current flowing through the circuit at the point where it's connected.

Remember to follow safety precautions, use appropriate instrument ranges, and avoid overloading the instruments. Incorrect connections or using the wrong settings can lead to inaccurate readings or damage to the equipment.

5. Measure the voltage, current with Multimeter and study the other measurements using Multimeter

Multimeter is a versatile electronic instrument that can measure various electrical quantities, including voltage and current. It often comes with additional measurement modes and features, including resistance, continuity, capacitance, and sometimes even temperature measurements. Some advanced multimeters may have built-in processors that enable additional functionalities. Here's how you can measure voltage and current using a multimeter and explore other measurements:

Measuring Voltage Using a Multimeter:

1. **Select Voltage Mode:** Turn the multimeter's dial to the DC (direct current) voltage mode or AC (alternating current) voltage mode, depending on the type of voltage you want to measure.
2. **Select Range:** Choose an appropriate voltage range on the multimeter's dial that is higher than the expected voltage. For example, if you expect the voltage to be around 12V, select a range like 20V or 50V.
3. **Connect Leads:** Insert the black (negative) lead into the COM (common) terminal and the red (positive) lead into the V Ω mA or V Ω terminal on the multimeter.
4. **Measure Voltage:** Touch the red lead to the point where you want to measure the voltage and the black lead to the reference point (ground). The multimeter will display the voltage reading on its screen.

Measuring Current Using a Multimeter:

1. **Select Current Mode:** Turn the multimeter's dial to the current (amps) mode. There may be different current range options such as mA (milliamps) and A (amps). Choose the appropriate range based on the expected current.
2. **Connect Leads:** Insert the red lead into the current (mA or A) terminal on the multimeter. The black lead remains in the COM (common) terminal.
3. **Break Circuit:** To measure current in series, you need to break the circuit and insert the multimeter in line.
4. **Measure Current:** Connect the multimeter in series with the circuit so that the current flows through the multimeter. The multimeter will display the current reading on its screen.

Exploring Other Measurements and Features: Depending on the features of your multimeter, you can explore additional measurements:

1. **Resistance:** Use the resistance mode to measure the resistance of resistors, components, or circuits.
2. **Continuity:** The continuity mode emits a beep or displays a value when a circuit is continuous (closed) or has low resistance, helping you identify broken wires or faulty connections.
3. **Capacitance:** Some multimeters can measure capacitance of capacitors, helping you determine their values.
4. **Temperature:** If your multimeter supports temperature measurements, it might have a temperature probe to measure temperatures in various applications.
5. **Diode Testing:** Multimeters with a diode test mode allow you to test diodes and other semiconductor components.
6. **Data Logging:** Advanced multimeters with processors might allow you to log measurements over time and analyze the data.

Always refer to your multimeter's user manual for specific instructions on how to use its features effectively and safely.

6. STUDY THE CRO AND MEASURE THE FREQUENCY AND PHASE OF GIVEN SIGNAL

A Cathode Ray Oscilloscope (CRO) is a versatile electronic instrument used to visualize and analyze electrical signals in the time domain. It's commonly used in electronics, physics, and engineering fields to study waveforms, measure frequencies, phases, and various characteristics of signals. Here's how you can use a CRO to measure the frequency and phase of a given signal:

Measuring Frequency Using a CRO:

1. **Connect the Signal:** Connect the signal source (signal generator or circuit output) to the input channel of the CRO using a suitable cable. Make sure the signal source and the CRO have a common ground connection.
2. **Adjust Vertical and Horizontal Controls:** Set the vertical sensitivity knob to an appropriate level so that the waveform is clearly visible on the screen. Adjust the horizontal timebase to a suitable time scale.
3. **Triggering:** Set the trigger mode to "Auto" or "Normal" depending on your requirement. Triggering synchronizes the waveform display on the screen.
4. **Measure Frequency:**
 - Ensure the timebase setting allows you to see several cycles of the waveform on the screen.
 - Count the number of complete cycles that are visible on the screen.
 - Determine the time duration (T) of these cycles using the timebase settings.
 - Frequency (f) can be calculated using the formula: $f = 1 / T$.

Measuring Phase Using a CRO:

1. **Connect Two Signals:** If you want to measure the phase difference between two signals, connect both signals to separate input channels of the CRO.
2. **Adjust Vertical and Horizontal Controls:** Adjust the vertical sensitivity and timebase settings for both channels to clearly display the waveforms.
3. **Triggering:** Set the triggering mode to synchronize the display of both waveforms.
4. **Measure Phase Difference:**
 - Identify corresponding points on the two waveforms. These could be peaks, zero crossings, or any specific features.
 - Measure the time difference (Δt) between the corresponding points on the two waveforms.
 - Calculate the phase difference (Φ) using the formula: $\Phi = 360 * (\Delta t / T)$, where T is the period of the waveform.

Remember that the phase difference is between 0° and 360° or between 0 and 2π radians, depending on your preference.

When using a CRO, it's essential to understand its controls, settings, and limitations. Additionally, the CRO's display quality, accuracy, and calibration can affect the precision of your measurements. Always refer to the CRO's user manual for specific instructions related to its usage and measurements.

7. DRAW THE VARIOUS LISSAJOUS FIGURES USING CRO

Lissajous figures are complex harmonic patterns that result from the combination of two sinusoidal waveforms with different frequencies and phase offsets. These figures are commonly displayed on an oscilloscope screen by feeding the two sinusoidal signals to the X and Y input channels of the oscilloscope.

Here's how you can create Lissajous figures using a CRO or a waveform generator:

1. **Connect the Signals:** Connect two sinusoidal signal sources (such as function generators) to the X and Y input channels of the oscilloscope. Make sure both signals are synchronized and share a common ground.
2. **Adjust Amplitude and Frequency:** Set the amplitude and frequency of both signals. You can experiment with different frequency ratios (like 2:3, 3:4, etc.) and amplitude settings to generate various Lissajous patterns.
3. **Adjust Phase Difference:** For each Lissajous figure, you'll need to set a specific phase difference between the two signals. This phase difference determines the shape of the figure.
4. **Select X-Y Mode:** Switch the oscilloscope to X-Y mode. This mode plots the Y signal against the X signal, creating the Lissajous figure on the screen.
5. **Observe the Pattern:** As you adjust the frequency ratio, amplitude, and phase difference, you'll see different Lissajous patterns appearing on the oscilloscope screen. The patterns can vary from simple ellipses to more complex shapes like butterflies, stars, and hearts.

The general equation for a Lissajous figure is:

$$x(t) = A_x \sin(at + \delta_x)$$

$$y(t) = A_y \sin(bt + \delta_y)$$

Where:

- A_x and A_y are the amplitudes of the X and Y signals.
- a and b are the frequencies of the X and Y signals in relation to each other.
- δ_x and δ_y are the phase differences of the X and Y signals.

By adjusting these parameters, you can generate a wide variety of Lissajous figures with different shapes and complexities.

8. STUDY THE FUNCTION GENERATOR FOR VARIOUS SIGNAL GENERATIONS

A function generator is an essential laboratory instrument used to generate various types of electronic waveforms for testing and experimentation in electronics and signal processing. It can produce a wide range of waveforms with controllable parameters such as frequency, amplitude, and duty cycle. Here are the main types of waveforms that a function generator can generate:

1. Sine Wave:

- The sine wave is the most basic waveform and represents a pure oscillation without harmonics.
- It's commonly used for testing analog circuits, audio equipment, and AC signal analysis.

2. Square Wave:

- A square wave alternates between two voltage levels (high and low) with sharp transitions.
- It's used to test digital circuits, clock signals, and for triggering purposes.

3. Triangle Wave:

- The triangle wave linearly ramps between its peak and valley over time.
- It's used in audio applications, waveform shaping, and function testing.

4. Sawtooth Wave:

- A sawtooth wave linearly ramps upward and then quickly resets to its starting point.
- It's used in frequency and time domain analysis and as a sweep signal in spectrum analyzers.

5. Pulse Wave:

- A pulse wave is similar to a square wave but has variable duty cycle (ratio of pulse width to period).
- It's used in applications like PWM (Pulse Width Modulation) control and signal integrity testing.

6. Ramp Wave:

- A ramp wave linearly increases or decreases in voltage over time.
- It's used in testing linear systems, servo control, and applications requiring linear voltage changes.

7. Arbitrary Waveform:

- Some advanced function generators allow you to create custom waveforms using mathematical equations or by loading predefined waveform patterns.
- This feature is useful for simulating complex signal scenarios and custom wave shapes.

Key features and controls of a function generator include:

- **Frequency Control:** Adjusts the frequency of the generated waveform.
- **Amplitude Control:** Sets the peak-to-peak voltage of the waveform.

- **Duty Cycle Control:** Adjusts the duty cycle for square and pulse waves.
- **Output Impedance:** Specifies the output impedance of the generator, affecting how it interacts with connected circuits.
- **Synchronization and Triggering:** Allows the generator to synchronize with external signals or trigger on specific events.
- **Modulation:** Some function generators offer amplitude modulation (AM), frequency modulation (FM), and pulse-width modulation (PWM) capabilities.
- **Arbitrary Waveform Editor:** If available, this feature enables you to create custom waveforms or load predefined ones.

9. STUDY OF SPECTRUM ANALYZER AND MEASURE THE SPECTRUM

How Spectrum Analyzers Work: A spectrum analyzer works by taking an input signal and breaking it down into its constituent frequency components. It displays the amplitude (power or voltage level) of each frequency component on a graphical display called a spectrum plot. The x-axis of the plot represents frequency, and the y-axis represents amplitude.

Here's a step-by-step guide on how to use a spectrum analyzer to measure the spectrum of a signal:

1. **Connect the Signal Source:** Connect the signal source (such as a signal generator or antenna) to the input of the spectrum analyzer.
2. **Set the Center Frequency:** Set the center frequency of the spectrum analyzer to the frequency of interest. This is the frequency around which the analyzer will focus its measurement.
3. **Adjust Span:** Adjust the span of the spectrum analyzer. The span defines the range of frequencies displayed on the screen. For example, if the center frequency is 1 GHz and the span is 1 MHz, the display will show frequencies from 999.5 MHz to 1000.5 MHz.
4. **Set Resolution Bandwidth (RBW):** The RBW determines the frequency resolution of the spectrum plot. A smaller RBW provides finer frequency detail but requires more time to make measurements.
5. **Set Video Bandwidth (VBW):** The VBW affects the smoothness of the displayed spectrum. A larger VBW provides a smoother display, while a smaller VBW can reveal transient events.
6. **Trigger Settings:** Configure the triggering settings to capture the signal properly. Depending on the signal type, you might use free-run (continuous) or external triggering.
7. **Measurement:** Once the settings are configured, start the measurement. The spectrum analyzer will display the amplitude of each frequency component within the specified span.
8. **Interpretation:** Analyze the displayed spectrum. Peaks in the spectrum plot correspond to frequency components in the signal. The height of each peak represents the amplitude of that frequency component.
9. **Frequency Markers:** Some spectrum analyzers allow you to place frequency markers on the plot to measure specific frequency components precisely.
10. **Save or Document:** If needed, save the measurement results or document the spectrum for further analysis or reporting.

10. OPERATE REGULATED POWER SUPPLY FOR DIFFERENT SUPPLY VOLTAGES

Operating a regulated power supply involves setting and controlling the output voltage to provide a stable and reliable source of power for electronic circuits and devices. Regulated power supplies are commonly used in various applications, including testing, prototyping, and powering electronic components

1. **Safety Precautions:**

- Before you begin, make sure you're working in a safe environment, and the power supply is properly grounded.
- Familiarize yourself with the specific controls and features of your regulated power supply by referring to its user manual.

2. **Connect the Load:**

- Connect the load (the electronic device or circuit you want to power) to the output terminals of the power supply.
- Ensure that the polarity of the connections is correct.

3. **Set the Output Voltage:**

- On the front panel of the power supply, locate the controls for setting the output voltage.
- Depending on the power supply, you might have a knob, buttons, or a digital interface to adjust the voltage.
- Set the desired output voltage using the control. Make sure the voltage is within the safe operating range of your load.

4. **Check Current Limit (if applicable):**

- Some regulated power supplies have current limiting capabilities to protect the load from excessive current.
- If your power supply has a current limit control, set it to a value that is appropriate for your load. This is especially important when testing circuits to prevent overloading.

5. **Enable Output:**

- Many regulated power supplies have an output enable/disable switch or button.
- Turn on the output of the power supply to provide voltage to the load.

6. **Monitor Voltage and Current:**

- Monitor the voltage and current readings on the power supply's display (if available).
- Make sure that the voltage and current levels are within the specified limits for your load.

7. **Adjust as Needed:**

- If your application requires changing the output voltage, use the power supply's controls to adjust it accordingly.
- Always adjust the voltage smoothly to prevent sudden changes that might affect your load.

8. **Turn Off Output:**

- When you're finished using the power supply, turn off the output to disconnect the power from your load.

9. **Disconnect Load:**

- Safely disconnect your load from the power supply.

10. **Power Down:**

- If you're done using the power supply, turn off its power using the main power switch.

