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| **Course Name:** | **Elements of Electrical and Electronics Engineering** | **Semester:** | **I** |
| **Date of Performance:** | **08 /09/2023** | **Batch No:** | **C4-1** |
| **Faculty Name:** |  | **Roll No:** | **11** |
| **Faculty Sign & Date:** |  | **Grade/Marks:** | **/ 25** |

**Experiment No: 1**

**Title:** **Study of types of Electronic and Electrical components and Instruments.**

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| **Aim and Objective of the Experiment:** |
| 1. To understand the working principle of various components and Instruments.  2. To understand the applications of various components and Instruments such as Bread Board,  Resistors, Capacitors, Inductors, Diodes, Cathode Ray Oscilloscope and Function Generator. |

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| **COs to be achieved:** |
| **CO1:** Analyze resistive networks excited by DC sources using various network theorems.  CO2: Demonstrate and analyze steady-state response of single-phase and three-phase circuits  CO4: Explain rectifier-filter circuits using the PN junction diode and voltage regulator circuits  using the Zener diode |

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| **Theory:**  A breadboard is a rectangular plastic board with a bunch of tiny holes in it. These holes let you easily insert electronic components to assemble an electronic circuit, like this one with a battery, switch, resistor, and an LED (light-emitting diode). The connections are not permanent, so it is easy to remove a component if you make a mistake, or just start over and do a new project. Remember that the inside of the breadboard is made up of sets of five metal clips. This means that each set of five holes forming a half-row (columns A–E or columns F–J) is electrically connected. For example, that means hole A1 is electrically connected to holes B1, C1, D1, and E1. It is not connected to hole A2, because that hole is in a different row, with a separate set of metal clips. It is also not connected to holes F1, G1, H1, I1, or J1.    Fig. Breadboard |
| **Resistors:** Those components and devices, that are specially designed to have a certain amount of resistance and used to oppose or limit the electric current, are called resistors. Each resistor has two main characteristics.   1. Its resistance value in ohms and 2) its power dissipating capacity in watts   Resistors are employed for many purposes such as electric heaters, telephone equipment, electric and electronic circuit elements, and current limiting devices. As resistors are used in wide applications, their values like power rating, R-value, and tolerance vary. Resistors of resistance values ranging from .1 ohms to many mega ohms are manufactured. Acceptable tolerance levels range from +/- 20% to as low as +/-.001%. The power rating may be as low as 1/10 watts and can be in several hundred watts. These all vary in range and type of application a particular resistor is used. Classification of Resistors: From operating conditions point of view, resistors can be classified into two   1. **Fixed resistors**      1. **Variable Resistor (POT):**   http://www.circuitstoday.com/wp-content/uploads/2009/08/variable-resistor-adjustable.png  1) Fixed resistors are further classified into:  a) Carbon composition type resistors  b) Metalized-type resistors  c) Wire wound-type resistors  **a) *Carbon composition type resistors*:**  This is the most common type of low-wattage resistor. The resistive material is of carbon-clay composition and the leads are made of tinned copper. These resistors are cheap and reliable and stability is high.  **b) *Wire wound resistors*:** These resistors are a length of wire wound and insulating cylindrical core. Usually, wires of material such as constantan (60% copper and 40% nickel) and manganin which have high resistivities and low-temperature coefficients are employed. The completed wire wound resistor is coated with an insulating material such as baked enamel.  **c) *Metalized resistors*:** It is constructed using film deposition techniques of depositing a thick film of resistive material onto an insulating substrate.  **2) Variable resistors:**  For circuits requiring a resistance that can be adjusted while it remains connected in the circuit (for eg: volume control on radio), variable resistors are required. They usually have 3 leads, two fixed and one movable.  **Resistor Color Code:**    **Capacitor:**  Electronic capacitors are one of the most widely used forms of electronic components. However, there are many different types of capacitors including electrolytic, ceramic, tantalum, plastic, silver mica, and many more. Each capacitor type has its advantages and disadvantages and can be used in different applications. Overview of different capacitor types Many different types of capacitors can be used - most of the major types are outlined below:  ***Ceramic capacitor:***   The ceramic capacitor is a type of capacitor that is used in many applications from audio to RF. Values range from a few Picofarads to around 0.1 microfarads. Ceramic capacitor types are by far the most commonly used type of capacitor being cheap and reliable and their loss factor is particularly low although this is dependent on the exact dielectric in use.  Related image  ***Electrolytic capacitor:***   Electrolytic capacitors are a type of capacitor that is polarized. They can offer high capacitance values - typically above 1μF and are most widely used for low-frequency applications - power supplies, decoupling, and audio coupling applications as they have a frequency limit of around 100 kHz.  An example of a close-up image of a leaded electrolytic capacitors showing the terminals and markings  ***Tantalum capacitor:***   Like electrolytic capacitors, tantalum capacitors are also polarized and offer a very high capacitance level for their volume. However, this type of capacitor is very intolerant of being reverse-biased, often exploding when placed under stress. This type of capacitor must also not be subject to high ripple currents or voltages above their working voltage.  Related image  ***Polystyrene Film Capacitor:***   Polystyrene capacitors are a relatively cheap form of capacitor but offer a close tolerance capacitor where needed. They are tubular resulting from the fact that the plate / dielectric sandwich is rolled together, but this adds inductance limiting their frequency response to a few hundred kHz. They are generally only available as leaded electronics components.Polystyrene Capacitor at Rs 1000/piece(s) | Polyester Film Capacitor,  पॉलिएस्टर कपैसिटर - Laxmi Sales Corporation, Vadodara | ID: 4115427291  ***Metallized Polyester Film Capacitor:***   This type of capacitor is essentially a form of polyester film capacitor where the polyester films themselves are metalized. The advantage of using this process is that because their electrodes are thin, the overall capacitor can be contained within a relatively small package. The metalized polyester film capacitors are generally only available as lead electronics components.  Electrical capacitors: Metalized Polyester Film capacitors  **Inductors:** Inductors have a wide variety and important applications in electronics. Inductors are available for high-power applications, noise suppression, radio frequency, signals, and isolation. Different inductor core types Like other types of components such as the capacitor, there are many different types of inductors. However, it can be a little more difficult to exactly define the different types of inductors because the variety of inductor applications is so wide.  Although it is possible to define an inductor by its core material, this is not the only way in which it can be categorized. However, for the basic definitions, this approach is used.  ***Air-cored inductor:***   This type of inductor is normally used for RF applications where the level of inductance required is smaller. The fact that no core is used has several advantages: there is no loss within the core as air is lossless, and this results in a high level of Q, assuming the inductor or coil resistance is low. Against this, the number of turns on the coil is larger to gain the same level of inductance and this may result in a physical increase in size.  What is an air core inductor? - Quora  ***Iron-cored inductor:***   Iron cores are normally used for high power and high inductance types of inductors. Some audio coils or chokes may use iron laminate. They are generally not widely used.  What are the applications of iron core inductor? - Semiconductor for You  ***Ferrite-cored inductor:***   Ferrite is one of the most widely used cores for a variety of types of inductors. Ferrite is a metal oxide ceramic based around a mixture of Ferric Oxide Fe2O3 and either manganese-zinc or nickel-zinc oxides which are extruded or pressed into the required shape.  Ferrite Core Inductors, फेराइट इंडक्टर in Perungudi, Chennai , Powercap  Transformer Technologies Private Limited | ID: 1781964912  ***Iron powder inductors:***   These are formed from very fine particles with insulated particles of highly pure iron powder. This type of inductor contains nearly 100% iron only. It gives us a solid-looking core when this iron powder is compressed under very high pressure and mixed with a binder such as epoxy or phenolic. By this action, iron powder forms like a magnetic solid structure which consists of a distributed air gap. Due to this air gap, it is capable of storing high magnetic flux when compared with the ferrite core. This characteristic allows a higher DC current level to flow through the inductor before the inductor saturates. This leads to reduced permeability of the core.    **Diodes:**  A diode is an electric device that permits the flow of current only in one direction and restricts the flow in the opposite direction. The most ordinary sort of diode in current circuit design is the semiconductor diode, even though additional diode technologies are present. The word “diode” is traditionally aloof for tiny signal appliances, I ≤ 1 A. When a diode is positioned in a simple battery lamp circuit, then the diode will either permit or stop the flow of current through the lamp, all this depends on the polarization of the volts applied. There are various sorts of diodes but their fundamental role is identical. The most ordinary kind of diode is a silicon diode.  Diode: Definition, Symbol, and Types of Diodes | Electrical4U  **Transistor:**  Bi-polar transistors are amongst the most widely used devices for amplification of all types of electrical signals in discrete circuits, i.e. circuits made from individual components rather than integrated circuits (I/Cs). BJTs are also used in circuits together with I/Cs since it is often more practical to use discrete output transistors where a higher power output is needed than the I/C can provide.   1. BUH515: High Voltage (1500V) high power (50W) NPN fast switching transistor in an ISO WATT 218 package originally designed for use in analog TV time bases but also used in switched mode power supplies. 2. 2N3055: NPN Silicon Power transistor (115W) designed for switching and amplifier applications. Can be used as one-half of a complementary push-pull output pair with the PNP MJ2955 transistor. 3. 2N2219: NPN silicon transistor in a metal-cased TO-39 package, designed for use as a high-speed switch or amplification at frequencies from DC (0Hz) up to UHF at about 500MHz. 4. 2N6487: General purpose NPN output transistor with a power rating of up to 75W in a TO-220 package. 5. BD135/BD136: Complementary (NPN/PNP) pair of low, medium power audio output transistors in a SOT-32 package. 6. 2N222: Small signal general-purpose amplifiers and switching transistors like the 2N2222 and 2N3904 are commonly available in a variety of package types such as the TO-18 metal-cased package (6)     **Switches:** A switch is a device that is designed to interrupt the current flow in a circuit, in other words, it can make or break an electrical circuit. Every electrical and electronics application uses at least one switch to perform the ON and OFF operation of the device.  Switches can be of mechanical or electronic type Mechanical Switches Mechanical switches can be classified into different types based on several factors such as the method of actuation (manual, limit, and process switches), number of contacts (single contact and multi-contact switches), number of poles and throws (SPST, DPDT, SPDT, etc.), operation and construction (push button, toggle, rotary, joystick, etc), based on state (momentary and locked switches), etc. Single Pole Single Throw Switch (SPST) https://www.electronicshub.org/wp-content/uploads/2015/09/1-1.jpg  This is the basic ON and OFF switch consisting of one input contact and one output contact. It switches a single circuit and it can either make (ON) or break (OFF) the load. The contacts of SPST can be either normally open or normally closed configurations.  SPDT Switch  **Single Pole Double Throw Switch (SPDT)**   * This switch has three terminals, one is input contact and the remaining two are output contacts. * This means it consists of two ON positions and one OFF position. * In most of the circuits, these switches are used as a changeover to connect the input between two choices of outputs.SPDT exmaple * The contact which is connected to the input by default is referred to as normally closed contact and contact which will be connected during ON operation is a normally open contact.   **Double Pole Single Throw Switch (DPST)**  DPST Switch   * This switch consists of four terminals, two input contacts, and two output contacts. * It behaves like two separate SPST configurations, operating at the same time. * It has only one ON position, but it can actuate the two contacts simultaneously, such that each input contact will be connected to its corresponding output contact. * In the OFF position both switches are in an open state. * This switch type is used to control two different circuits at a time. * Also, the contacts of this switch may be either normally open or normally closed configurations.   **Double Pole Double Throw Switch (DPDT)**  DPDT Switch DPDT Example   * This is a dual ON/OFF switch consisting of two ON positions. * It has six terminals, two are input contacts and the remaining four are output contacts. * It behaves like two separate SPDT configurations, operating at the same time. * Two input contacts are connected to the one set of output contacts in one position and another position, input contacts are connected to the other set of output contact   **Push Button Switch**  PushButton   * It is a momentary contact switch that makes or breaks a connection as long as pressure is applied (or when the button is pushed). * Generally, this pressure is supplied by a button pressed by someone’s finger. * This button returns to its normal position, once the pressure is removed. * The internal spring mechanism operates these two states (pressed and released) of a push button. * It consists of stationary and movable contacts, of which stationary contacts are connected in series with the circuit to be switched while movable contacts are attached with a push button. * Push buttons are majorly classified into normally open, normally closed, and double-acting push buttons as shown in the above figure. * Double-acting push buttons are generally used for controlling two electrical circuits.   **Toggle Switch**  ToggleSwitch   * A toggle switch is manually actuated (or pushed up or down) by a mechanical handle, lever, or rocking mechanism. These are commonly used as light control switches. * Most of these switches come with two or more lever positions which are in the versions of SPDT, SPST, DPST, and DPDT switches. These are used for switching high currents (as high as 10 A) and can also be used for switching small currents. * These are available in different ratings, sizes, and styles and are used for different types of applications. The ON condition can be any of their level positions, however, by convention the downward is the closed or ON position   **Function Generator:**  Multi-Waveform Signal Generator can be used as a signal source to check amplifiers, filters, and attenuators and also to generate circuit-based signals. The wide Frequency range from 0.01Hz up to 1MHz / 2MHz / 3MHz through coarse and fine controls makes quick adjustment possible.    It has the following features: a) Wide Frequency Range b) Sine, Triangle, Square, Ramp, Pulse, TTL (Sync) & DC Outputs c) Low Distortion High Resolution on Low Frequency Output Attenuation up to 80dB d) Variable DC Offset Control and e) Four Digit Digital Display with Frequency Indication in Hz, KHz, MHz / Amplitude display.  **Cathode Ray Oscilloscope (CRO)**  The cathode ray oscilloscope is an electronic test instrument; it is used to obtain waveforms when different input signals are given. The oscilloscope observes the changes in the electrical signals over time, thus the voltage and time describe a shape and it is continuously graphed beside a scale. By seeing the waveform, we can analyze some properties like amplitude, frequency, rise time, distortion, time interval, etc. A built-in Component Tester makes it an indispensable instrument, as this allows testing of both passive and active components, while connected in-circuit. The one used in the lab is a 30 MHz Oscilloscope with a Color LCD Digital Readout and component Tester.  l,    **Some of the Panel controls are described below:** |

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| **Observation Table:**  Apply a known amplitude and frequency of sine/triangular/square waveform from the signal generator and connect it to one of the channels of the CRO for measurement. |
| **Table 1**   |  |  |  | | --- | --- | --- | | **Color code of Resistor/Capacitor** | **Theoretical Value** | **Practical Value (DMM)** | | **Brown, Black, Brown, Gold** | **100 ± 5% ohm** | **0.10 kΩ** | | **Red, Red, Red, Gold** | **2.2 ± 5% kΩ** | **2.15 kΩ** | | **Grey, Red, Brown, Gold** | **0.82 + 5% kΩ** | **0.81 kΩ** |   **Table 2**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Waveform Nature** | **Theoretical** | **Measured frequency (Hz)** | **Theoretical** | **Measured amplitude peak to peak (V)** | | **Sine wave** | **1KHz** | **1.003KHz** | **6V** | **5.28V** | | **Square wave** | **1MHz** | **1.049MHz** | **8V** | **7.60V** | | **Triangular wave** | **500Hz** | **500Hz** | **10V** | **10.1V** | |

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| **Post Lab Subjective:** |
| 1. State the functions of C.R.O  Ans:-The cathode ray oscilloscope is an electronic test instrument; it is used to obtain waveforms when different input signals are given. The oscilloscope observes the changes in the electrical signals over time, thus the voltage and time describe a shape and it is continuously graphed beside a scale.  2. How does PN junction diode work? Where is it used?  Ans:-a PN junction diode allows the flow of electric current in one direction (forward bias) while blocking it in the other direction (reverse bias). This property makes it useful in a wide range of applications, including rectification, signal clipping, voltage regulation, and more.  It can be used to allow the flow of current in only one direction in a full-cycle rectifier to convert AC Current to DC current |

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| **Conclusion:** |
| The items used in this experiment introduce various electronic equipment used in electric circuits which help us understand how things work  The equipment we used in the experiments are:- resistor, Multimeter, Oscilloscope, DC source, AC source    **Triangular wave**    **Square wave**    **Sine wave** |

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| **Signature of faculty in charge with Date:** |