KWARA STATE POLYTECHNIC

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A TECHNICAL REPORT OF STUDENTS INDUSTRIAL WORK EXPERIENCE SCHEME (SIWES) REPORT

HELD AT:

MUSTECH ELECTRONICS LAB INTEGRATED ELECTRONIC TECHNOLOGY AND CONSULTANT

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SUBMITTED TO:
DEPARTMENT OF ELECTRICAL ELECTRONICS ENGINEERING, INSTITUTE OF TECHNOLOGY, KWARA STATE POLYTECHNIC, ILORIN IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF NATIONAL DIPLOMA

AUGUST - NOVEMBER 2024

DEDICATION

I dedicate this SIWES Works to Almighty Allah whose supremacy in the knowledge of everything is absolute and my parent **Mr. and Mrs. SOLIU**

ACKNOWLEDGEMENT

All thanks to Almighty Allah, the creator of the worlds, for His protection, mercy, goodness and favor throughout my SIWES programme and also for improving to pass through part of the hurdles of my education.

My special appreciation goes to my parents MR. and MRS. Soliu May God abundantly reward you all (Amen).

Special thanks to all my friends and colleagues who stood by me till now with their patience and understanding to make little out of no time for them to guide and correct me throughout the period of his work and to my SIWES thank you all.

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CHAPTER ONE

1.1 INTRODUCTION TO SIWES

The student industry work experience scheme (SIWES) is the acceptable skills training program which forms part of the approval minimum academic standard in the various degree programs for all Nigerian tertiary institutions.

It is an effort ti bridge the gap existing between theory and practical of science, Engineering and Technology, Agriculture, Management and all other professional education program in Nigerian tertiary institutions.

It is aimed at exposing students to machine and equipment professional work method and way of safe guarding other organizations. The scheme is a tripartite program involving the polytechnic, university and college of Education all going into the industries [employer of labor].

1.2 BACKGROUND OF SIWES

The student industrial work experience scheme (SIWES) is a skills training program designed to expose and prepare student of higher institution for the working environment they are likely to meet after graduation. SIWES was established by industrial Training Fund (ITF) in 1973 to solve the problem of lack of adequate practical skills, in preparation for employment in industries by Nigerian graduates.

The SIWES program runs in the Nigeria universities in conjunction with the industrial Training Fund unit, to promote practical in tertiary institutions. The aim of the program is to bridge the gap existing between theoretical aspects of what is being taught in the lecture rooms and what is actually obtained in the field it is aimed at exposing students to challenges they are likely to come across upon their graduation from the universities and to adequately expose students to professional work methods.

Participation in industry training is a well known strategy. Classroom studies are integrated with learning through hands-on work experience in a field related to the student academic major and career goal. It enhances an experiential learning process that not only promotes career preparation but also provides opportunities for learning to develop skills necessary to become leaders in their chosen profession.

Participation in SIWES has become a necessary pre-condition for the award of Diploma and Degree certification in specific discipline in most institutions of higher learning in the country in accordance with the educational policy of government.

OPERATORS OF THE SIWES PROGRAM: the industrial training fund (ITF), employers of labour, the higher institutions, and some coordinating agencies like Nigeria Universities commission (NUC), National commission for civic Education (NCCE) and national Board for Technical Education (NBTE) are the operators of this program.

FUNDING: the federal government of Nigeria fund this program

BENEFICIARIES: undergraduate students of the following Agricultural, Engineering Technology, Environmental, Science, Medical sciences and pure and Applied Science.

DURATION: one year for polytechnic, four months for college of education and six months for the Universities.

1.3 AIMS AND OBJECTIVES OF SIWES

AIMS:

The aims of the student industrial work experience scheme (SIWES) are as fellows

- To expose students to industrial base skills necessary for smooth transition from classroom to the world and the applicability of work done in various schools go meet the industrial demand.
- To bridge the gap existing between theoretical aspects of what is being taught in the lecture rooms and practical aspects what is actually gained in the field.

- To expose students to the challenges they are likely to come across upon their graduation from the university and to adequately expose student to professional work methods.

OBJECTIVES:

- Expose students to work method and techniques in handling equipment and machinery that may not be available in the school.
- Prepare students for the work situation they are likely to meet after graduation.
- To provide an avenue for students in the Nigeria universities & polytechnic to acquire industrial skills and experience in their course of study.
- To make the transition from polytechnic to the world of work easier and enhance student contact for later job placement.
- Provide students with an opportunity to apply their theoretical knowledge in real work situations thereby bridging the gap between polytechnic work and actual practice.

CHAPTER TWO

2.1 BRIEF HISTORY OF THE ORGANIZATION

Mustech Electronics Lab, Integrated Electronics Technology and Consultant, is based in Ilorin, Nigeria. The company has been involved in providing practical training opportunities for engineering students through the Student Industrial Work Experience Scheme (SIWES). For example, students like Sulaimon Ismail Olamilekan and Zainab have completed four-month SIWES programs at Mustech Electronics Lab, gaining hands-on experience in electronic technologies.

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Additionally, professionals such as Abdulrahman Olayiwola Ibrahim have interned at Mustech Electronics Lab, focusing on areas like embedded systems, IoT, and PCB design. ng.linkedin.com

Specifi details about the founding date and comprehensive history of Mustech Electronics Lab are not readily available in the provided sources.

2.2 MISSION AND VISION OF ORGANIZATION

VISION

To be Excellent in Sustainable Infrastructure Development and Service Delivery

MISSION

To facilitate the provision of adequate and affordable housing for all Nigerians in both urban and rural areas in a secure, healthy and decent environment through access to functional Nigerian roads at all times

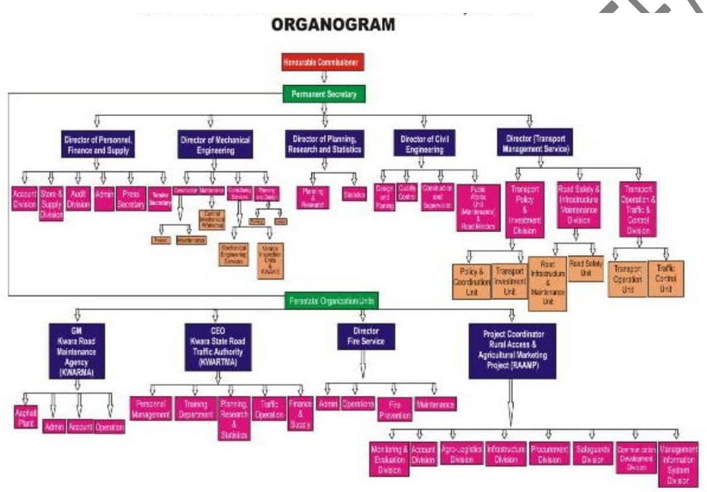
To pursue economic empowerment and development with the following major components:

- Provision of basic amenities
- Improving Infrastructure
- Poverty alleviation programmer

- Skills Acquisition Programme
- Private Sector Partnership

2.3 STRUCTURE OF ORGANIZATION

An organization structure can improve or hinder efficiency in an organization. The structure plays a crucial role in an organization. It defines the allocation of responsibilities and powers, reporting relationships and processes, hierarchy levels and value added, allocation resources and determining skills requirement and affordability.



CHAPTER THREE

3.1 ELECTRONIC DEVICES

This article is about the technical field. For personal/home-use electronic devices, see consumer electronics. For the journal, see Electronics (magazine).

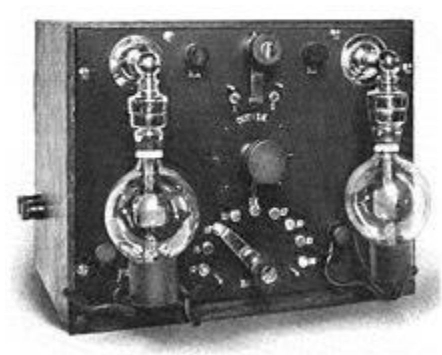
Modern surface-mount electronic components on a printed circuit board, with a large integrated circuit at the top

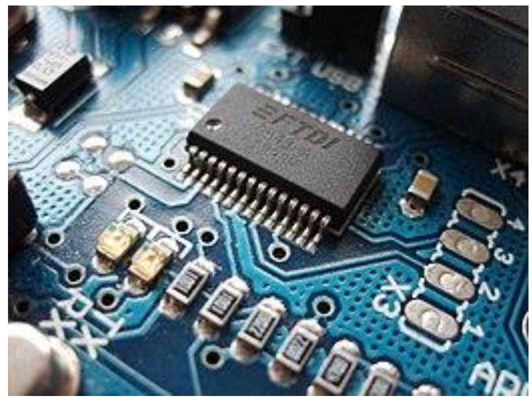
Electronics is a scientific and engineering discipline that studies and applies the principles of physics to design, create, and operate devices that manipulate electrons and other electrically charged particles. It is a subfield of physics[1][2] and electrical engineering which uses active devices such as transistors, diodes, and integrated circuits to control and amplify the flow of electric current and to convert it from one form to another, such as from alternating current (AC) to direct current (DC) or from analog signals to digital signals.

Electronic devices have hugely influenced the development of many aspects of modern society, such as telecommunications, entertainment, education, health care, industry, and security. The main driving force behind the advancement of electronics is the semiconductor industry, which in response to global demand continually produces ever-more sophisticated electronic devices and circuits. The semiconductor industry is one of the largest and most profitable sectors in the global economy, with annual revenues exceeding $481 billion in 2018. The electronics industry also encompasses other sectors that rely on electronic devices and systems, such as e-commerce, which generated over $29 trillion in online sales in 2017.

3.2 HISTORY AND DEVELOPMENT

History of electronic engineering and Timeline of electrical and electronic engineering





One of the earliest Audion radio receivers, constructed by De Forest in 1914

The identification of the electron in 1897 by Sir Joseph John Thomson, along with the subsequent invention of the vacuum tube which could amplify and rectify small electrical signals, inaugurated the field of electronics and the electron age.[3] Practical applications started with the invention of the diode by Ambrose Fleming and the triode by Lee De Forest in the early 1900s, which made the detection of small electrical voltages, such as radio signals from a radio antenna, practicable.

Vacuum tubes (thermionic valves) were the first active electronic components which controlled current flow by influencing the flow of individual electrons, and enabled the construction of equipment that used current amplification and rectification to give us radio, television, radar, long-distance telephony and much more. The early growth of electronics was rapid, and by the 1920s, commercial radio broadcasting and telecommunications were becoming widespread and electronic amplifiers were being used in such diverse applications as long-distance telephony and the music recording industry.[4]

The next big technological step took several decades to appear, when the first working point-contact transistor was invented by John Bardeen and Walter Houser Brattain at Bell Labs in 1947.[5] However, vacuum tubes continued to play a leading role in the field of microwave and high power transmission as well as television receivers until the middle of the 1980s.[6] Since then, solid-state devices have all but completely taken over. Vacuum tubes are still used in some specialist applications such as high power RF amplifiers, cathode-ray tubes, specialist audio equipment, guitar amplifiers and some microwave devices.

In April 1955, the IBM 608 was the first IBM product to use transistor circuits without any vacuum tubes and is believed to be the first all-transistorized calculator to be manufactured for the commercial market.[7][8] The 608 contained more than 3,000 germanium transistors. Thomas J. Watson Jr. ordered all future IBM products to use transistors in their design. From that time on transistors were almost exclusively used for computer logic circuits and peripheral devices. However, early junction transistors were relatively bulky devices that were difficult to manufacture on a mass-production basis, which limited them to a number of specialised applications.[9]

The MOSFET was invented at Bell Labs between 1955 and 1960.[10][11][12][13][14][15] It was the first truly compact transistor that could be miniaturised and mass-produced for a wide range of uses. Its advantages include high scalability,[16] affordability,[17] low power consumption, and high density. It revolutionized the electronics industry,[19][20] becoming the most widely used electronic device in the world. The MOSFET is the basic element in most modern electronic equipment

As the complexity of circuits grew, problems arose.[25] One problem was the size of the circuit. A complex circuit like a computer was dependent on speed. If the components were large, the wires interconnecting them must be long. The electric signals took time to go through the circuit, thus slowing the computer.[25] The invention of the integrated circuit by Jack Kilby and Robert Noyce solved this problem by making all the components and the chip out of the same block (monolith) of semiconductor material. The circuits could be made smaller, and the manufacturing process could be automated. This led to the idea of integrating all components on a single-crystal silicon wafer, which led to small-scale integration (SSI) in the early 1960s, and then medium-scale integration (MSI) in the late 1960s, followed by VLSI. In 2008, billion-transistor processors became commercially available

3.3 TYPES OF CIRCUITS

Electronic circuit functions can be divided into two function groups: analog and digital. A particular device may consist of circuitry that has either or a mix of the two types. Analog circuits are becoming less common, as many of their functions are being digitized

A **light-emitting diode**

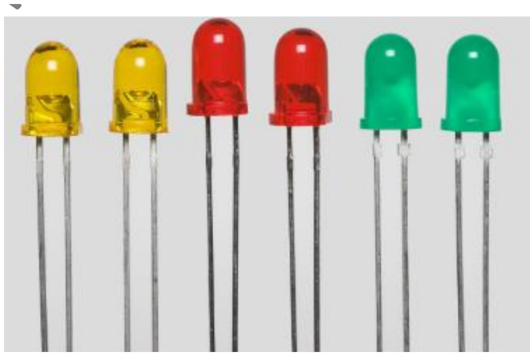
A **light-emitting diode** (**LED**) is a semiconductor device that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons. The color of the light (corresponding to the energy of the photons) is determined by the energy required for electrons to cross the band gap of the semiconductor.[5] White light is obtained by using multiple semiconductors or a layer of light-emitting phosphor on the semiconductor device.[6]

Appearing as practical electronic components in 1962, the earliest LEDs emitted low-intensity infrared (IR) light.[7] Infrared LEDs are used in remote-control circuits, such as those used with a wide variety of consumer electronics. The first visible-light LEDs were of low intensity and limited to red.

Early LEDs were often used as indicator lamps, replacing small incandescent bulbs, and in seven-segment displays. Later developments produced LEDs available in visible, ultraviolet (UV), and infrared wavelengths with high, low, or intermediate light output, for instance, white LEDs suitable for room and outdoor lighting. LEDs have also given rise to new types of displays and sensors, while their high switching rates are useful in advanced communications technology. LEDs have been used in diverse applications such as aviation lighting, fairy lights, strip lights, automotive headlamps, advertising, general lighting, traffic signals, camera flashes, lighted wallpaper, horticultural grow lights, and medical devices.[8]

LEDs have many advantages over incandescent light sources, including lower power consumption, a longer lifetime, improved physical robustness, smaller sizes, and faster switching. In exchange for these generally favorable attributes, disadvantages of LEDs include electrical limitations to low voltage and generally to DC (not AC) power, the inability to provide steady illumination from a pulsing DC or an AC electrical supply source, and a lesser maximum operating temperature and storage temperature.

LEDs are transducers of electricity into light. They operate in reverse of photodiodes, which convert light into electricity.



CHAPTER FOUR

4.1 RESISTOR

A **resistor** is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses. High-power resistors that can dissipate many watts of electrical power as heat may be used as part of motor controls, in power distribution systems, or as test loads for generators. Fixed resistors have resistances that only change slightly with temperature, time or operating voltage. Variable resistors can be used to adjust circuit elements (such as a volume control or a lamp dimmer), or as sensing devices for heat, light, humidity, force, or chemical activity.

Resistors are common elements of electrical networks and electronic circuits and are ubiquitous in electronic equipment. Practical resistors as discrete components can be composed of various compounds and forms. Resistors are also implemented within integrated circuits.

The electrical function of a resistor is specified by its resistance: common commercial resistors are manufactured over a range of more than nine orders of magnitude. The nominal value of the resistance falls within the manufacturing tolerance, indicated on the component.

4.2 SWITCH

In electrical engineering, a **switch** is an electrical component that can disconnect or connect the conducting path in an electrical circuit, interrupting the electric current or diverting it from one conductor to another.[1][2] The most common type of switch is an electromechanical device consisting of one or more sets of movable electrical contacts connected to external circuits. When a pair of contacts is touching current can pass between them, while when the contacts are separated no current can flow.

Switches are made in many different configurations; they may have multiple sets of contacts controlled by the same knob or actuator, and the contacts may operate simultaneously, sequentially, or alternately. A switch may be operated manually, for example, a light switch or a keyboard button, or may function as a sensing element to sense the position of a machine part, liquid level, pressure, or temperature, such as a thermostat. Many specialized forms exist, such as the toggle switch, rotary switch, mercury switch, push-button switch, reversing switch, relay, and circuit breaker. A common use is control of lighting, where multiple switches may be wired into one circuit to allow convenient control of light fixtures. Switches in high-powered circuits must have special construction to prevent destructive arcing when they are opened.

Three push button switches (Tactile Switches). Major scale is inches.

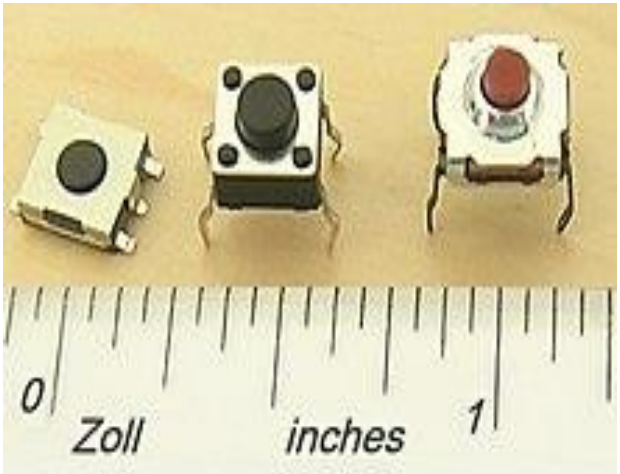
The most familiar form of switch is a manually operated electromechanical device with one or more sets of electrical contacts, which are connected to external circuits. Each set of contacts can be in one of two states: either "closed" meaning the contacts are touching and electricity can flow between them, or "open", meaning the contacts are separated and the switch is nonconducting. The mechanism actuating the transition between these two states (open or closed) is usually (there are other types of actions) either an "alternate action" (flip the switch for continuous "on" or "off") or "momentary" (push for "on" and release for "off") type.

A switch may be directly manipulated by a human as a control signal to a system, such as a computer keyboard button, or to control power flow in a circuit, such as a light switch. Automatically operated switches can be used to control the motions of machines, for example, to indicate that a garage door has reached its full open position or that a machine tool is in a position to accept another workpiece. Switches may be operated by process variables such as pressure, temperature, flow, current, voltage, and force, acting as sensors in a process and used to automatically control a system. For example, a thermostat is a temperature-operated switch used to control a heating process. A switch that is operated by another electrical circuit is called a relay. Large switches may be remotely operated by a motor drive mechanism. Some switches are used to isolate electric power from a system, providing a visible point of isolation that can be padlocked if necessary to prevent accidental operation of a machine during maintenance, or to prevent electric shock.

An ideal switch would have no voltage drop when closed, and would have no limits on voltage or current rating. It would have zero rise time and fall time during state changes, and would change state without "bouncing" between on and off positions.

Practical switches fall short of this ideal; as the result of roughness and oxide films, they exhibit contact resistance, limits on the current and voltage they can handle, finite switching time, etc. The ideal switch is often used in circuit analysis as it greatly simplifies the system of equations to be solved, but this can lead to a less accurate solution.

Theoretical treatment of the effects of non-ideal properties is required in the design of large networks of switches, as for example used in telephone exchanges.



4.3 CAPACITOR

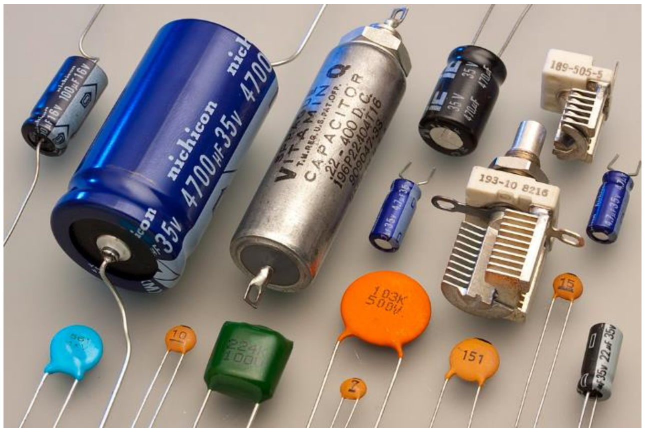
In electrical engineering, a **capacitor** is a device that stores electrical energy by accumulating electric charges on two closely spaced surfaces that are insulated from each other. The capacitor was originally known as the **condenser**,[1] a term still encountered in a few compound names, such as the condenser microphone. It is a passive electronic component with two terminals.

The utility of a capacitor depends on its capacitance. While some capacitance exists between any two electrical conductors in proximity in a circuit, a capacitor is a component designed specifically to add capacitance to some part of the circuit.

The physical form and construction of practical capacitors vary widely and many types of capacitor are in common use. Most capacitors contain at least two electrical conductors, often in the form of metallic plates or surfaces separated by a dielectric medium. A conductor may be a foil, thin film, sintered bead of metal, or an electrolyte. The nonconducting dielectric acts to increase the capacitor's charge capacity. Materials commonly used as dielectrics include glass, ceramic, plastic film, paper, mica, air, and oxide layers. When an electric potential difference (a voltage) is applied across the terminals of a capacitor, for example when a capacitor is connected across a battery, an electric field develops across the dielectric, causing a net positive charge to collect on one plate and net negative charge to collect on the other plate. No current actually flows through a perfect dielectric. However, there is a flow of charge through the source circuit. If the condition is maintained sufficiently long, the current through the source circuit ceases. If a time-varying voltage is applied across the leads of the capacitor, the source experiences an ongoing current due to the charging and discharging cycles of the capacitor.

Capacitors are widely used as parts of electrical circuits in many common electrical devices. Unlike a resistor, an ideal capacitor does not dissipate energy, although real-life capacitors do dissipate a small amount (see Non-ideal behavior).

The earliest forms of capacitors were created in the 1740s, when European experimenters discovered that electric charge could be stored in water-filled glass jars that came to be known as Leyden jars. Today, capacitors are widely used in electronic circuits for blocking direct current while allowing alternating current to pass. In analog filter networks, they smooth the output of power supplies. In resonant circuits they tune radios to particular frequencies. In electric power transmission systems, they stabilize voltage and power flow.[2] The property of energy storage in capacitors was exploited as dynamic memory in early digital computers,[3] and still is in modern DRAM.



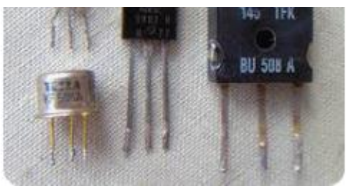
4.4 TRANSISTOR

A **transistor** is a semiconductor device used to amplify or switch electrical signals and power. It is one of the basic building blocks of modern electronics.[1] It is composed of semiconductor material, usually with at least three terminals for connection to an electronic circuit. A voltage or current applied to one pair of the transistor's terminals controls the current through another pair of terminals. Because the controlled (output) power can be higher than the controlling (input) power, a transistor can amplify a signal. Some transistors are packaged individually, but many more in miniature form are found embedded in integrated circuits. Because transistors are the key active components in practically all modern electronics, many people consider them one of the 20th century's greatest inventions.[2]

Physicist Julius Edgar Lilienfeld proposed the concept of a field-effect transistor (FET) in 1925, but it was not possible to construct a working device at that time.[4] The first working device was a point-contact transistor invented in 1947 by physicists John Bardeen, Walter Brattain, and William Shockley at Bell Labs who shared the 1956 Nobel Prize in Physics for their achievement.[5] The most widely used type of transistor, the metal–oxide–semiconductor field-effect transistor (MOSFET), was invented at Bell Labs between 1955 and 1960.

Transistors revolutionized the field of electronics and paved the way for smaller and cheaper radios, calculators, computers, and other electronic devices.

Most transistors are made from very pure silicon, and some from germanium, but certain other semiconductor materials are sometimes used. A transistor may have only one kind of charge carrier in a field-effect transistor, or may have two kinds of charge carriers in bipolar junction transistor devices. Compared with the vacuum tube, transistors are generally smaller and require less power to operate. Certain vacuum tubes have advantages over transistors at very high operating frequencies or high operating voltages, such as Traveling-wave tubes and Gyrotrons. Many types of transistors are made to standardized specifications by multiple manufacturers.



4.5 JUMPER WIRE

A **jump wire** (also known as **jumper**, **jumper wire**, **DuPont wire**) is an electrical wire, or group of them in a cable, with a connector or pin at each end (or sometimes without them – simply "tinned"), which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering.[1]

Individual jump wires are fitted by inserting their "end connectors" into the slots provided in a breadboard, the header connector of a circuit board, or a piece of test equipment.

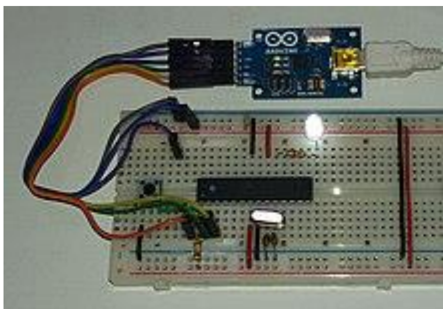
4.5.1 Types

Jumper wires with crocodile clipsJump wires at the end of a multi-colored ribbon cable are used to connect the pin header at the left side of a blue USB2Serial board to a white breadboard below. Another jumper cable ending in a USB micro male connector mates to the right side of the USB2Serial board. Red and black tinned jump wires can be seen on the breadboard.

There are different types of jumper wires. Some have the same type of electrical connector at both ends, while others have different connectors. Some common connectors are:

- Solid tips – are used to connect on/with a breadboard or female header connector. The arrangement of the elements and ease of insertion on a breadboard allows increasing the mounting density of both components and jump wires without fear of short-circuits. The jump wires vary in size and colour to distinguish the different working signals.
- Crocodile clips – are used, among other applications, to temporarily bridge sensors, buttons and other elements of prototypes with components or equipment that have arbitrary connectors, wires, screw terminals, etc.
- Banana connectors – are commonly used on test equipment for DC and low-frequency AC signals.
- Registered jack (RJnn) – are commonly used in telephone (RJ11) and computer networking (RJ45).
- RCA connectors – are often used for audio, low-resolution composite video signals, or other low-frequency applications requiring a shielded cable.
- RF connectors – are used to carry radio frequency signals between circuits, test equipment, and antennas.

- RF jumper cables - Jumper cables is a smaller and more bendable corrugated cable which is used to connect antennas and other components to network cabling. Jumpers are also used in base stations to connect antennas to radio units. Usually the most bendable jumper cable diameter is 1/2".



4.6 INTEGRATE CIRCUIT

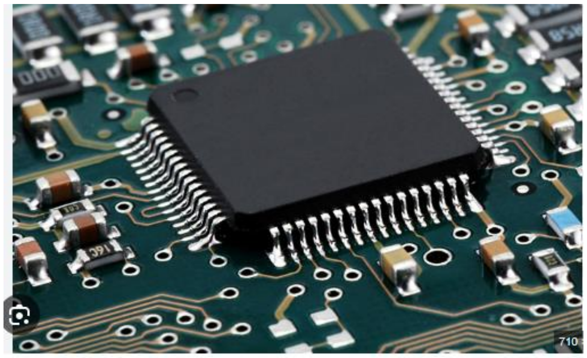
An **integrated circuit** (**IC**), also known as a **microchip** or simply **chip**, is a set of electronic circuits, consisting of various electronic components (such as transistors, resistors, and capacitors) and their interconnections.[1] These components are etched onto a small, flat piece ("chip") of semiconductor material, usually silicon.[1] Integrated circuits are used in a wide range of electronic devices, including computers, smartphones, and televisions, to perform various functions such as processing and storing information. They have greatly impacted the field of electronics by enabling device miniaturization and enhanced functionality.

Integrated circuits are orders of magnitude smaller, faster, and less expensive than those constructed of discrete components, allowing a large transistor count.

The IC's mass production capability, reliability, and building-block approach to integrated circuit design have ensured the rapid adoption of standardized ICs in place of designs using discrete transistors. ICs are now used in virtually all electronic equipment and have revolutionized the world of electronics. Computers, mobile phones, and other home appliances are now essential parts of the structure of modern societies, made possible by the small size and low cost of ICs such as modern computer processors and microcontrollers.

Very-large-scale integration was made practical by technological advancements in semiconductor device fabrication. Since their origins in the 1960s, the size, speed, and capacity of chips have progressed enormously, driven by technical advances that fit more and more transistors on chips of the same size – a modern chip may have many billions of transistors in an area the size of a human fingernail. These advances, roughly following Moore's law, make the computer chips of today possess millions of times the capacity and thousands of times the speed of the computer chips of the early 1970s.

ICs have three main advantages over circuits constructed out of discrete components: size, cost and performance. The size and cost is low because the chips, with all their components, are printed as a unit by photolithography rather than being constructed one transistor at a time. Furthermore, packaged ICs use much less material than discrete circuits. Performance is high because the IC's components switch quickly and consume comparatively little power because of their small size and proximity. The main disadvantage of ICs is the high initial cost of designing them and the enormous capital cost of factory construction. This high initial cost means ICs are only commercially viable when high production volumes are anticipated.



4.7 VOLTAGE

Voltage, also known as **(electrical) potential difference**, **electric pressure**, or **electric tension** is the difference in electric potential between two points. In a static electric field, it corresponds to the work needed per unit of charge to move a positive test charge from the first point to the second point. In the International System of Units (SI), the derived unit for voltage is the volt (V).

The voltage between points can be caused by the build-up of electric charge (e.g., a capacitor), and from an electromotive force (e.g., electromagnetic induction in a generator). On a macroscopic scale, a potential difference can be caused by electrochemical processes (e.g., cells and batteries), the pressure-induced piezoelectric effect, and the thermoelectric effect. Since it is the difference in electric potential, it is a physical scalar quantity.[8]

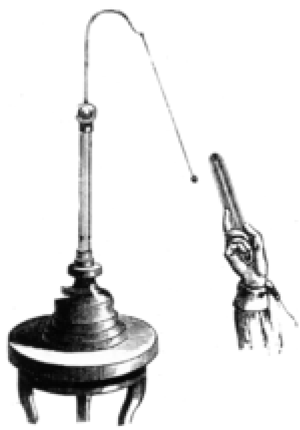
A voltmeter can be used to measure the voltage between two points in a system.[9] Often a common reference potential such as the ground of the system is used as one of the points. In this case, voltage is often mentioned at a point without completely mentioning the other measurement point. A voltage can be associated with either a source of energy or the loss, dissipation, or storage of energy.

Definition

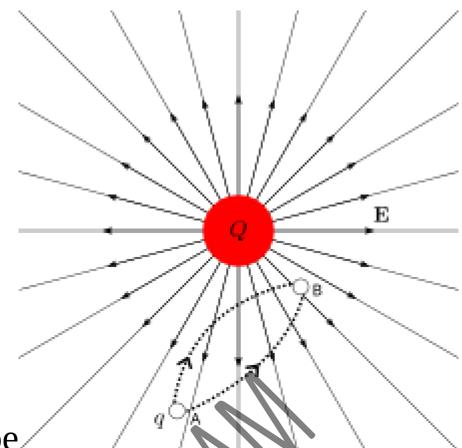
The SI unit of work per unit charge is the joule per coulomb, where 1 volt = 1 joule (of work) per 1 coulomb of charge. The old SI definition
for volt used power and current; starting in 1990, the quantum Hall and Josephson effect were used, and in 2019 physical constants were given defined values for the definition of all SI units.

Voltage is denoted symbolically by , simplified V, especially in English-speaking countries. Internationally, the symbol U is standardized. It is used, for instance, in the context of Ohm's or Kirchhoff's circuit laws.
The electrochemical potential is the voltage that can be directly measured with a voltmeter. The Galvani potential that exists in structures with junctions of dissimilar materials is also work per charge but cannot be measured with a voltmeter in the external circuit (see § Galvani potential vs. electrochemical potential).
Voltage is defined so that negatively charged objects are pulled towards higher voltages, while positively charged objects are pulled towards lower voltages. Therefore, the conventional current in a wire or resistor always flows from higher voltage to lower voltage.
Historically, voltage has been referred to using terms like "tension" and "pressure". Even today, the term "tension" is still used, for example within the phrase "high tension" (HT) which is commonly used in the contexts of automotive electronics and systems using thermionic valves (vacuum tubes).

4.8 ELECTROSTATICS



The electric field around the rod exerts a force on the charged pith ball, in



an electroscope

In a static field, the work is independent of the path

Main article: Electric potential § Electrostatics

In this case, the voltage increase from point A to point B is equal to the work done per unit charge, against the electric field, to move the charge from A to B without causing any acceleration. Mathematically, this is expressed as the line integral of the electric field along that path. In electrostatics, this line integral is independent of the path taken.[17]:91

Under this definition, any circuit where there are time-varying magnetic fields, such as AC circuits, will not have a well-defined voltage between nodes in the circuit, since the electric force is not a conservative force in those cases. However, at lower frequencies when the electric and magnetic fields are not rapidly changing, this can be neglected (see electrostatic approximation).

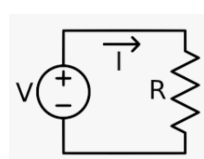
Electrodynamics

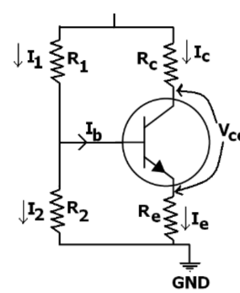
The electric potential can be generalized to electrodynamics, so that differences in electric potential between points are well-defined even in the presence of time-varying fields. However, unlike in electrostatics, the electric field can no longer be expressed only in terms of the electric potential. Furthermore, the potential is no longer uniquely determined up to a constant, and can take significantly different forms depending on the choice of gauge

In this general case, some authors[18] use the word "voltage" to refer to the line integral of the electric field, rather than to differences in electric potential. In this case, the voltage rise along some path from to is given by:

However, in this case the "voltage" between two points depends on the path taken.

$$\Delta V_{AB} = V(\mathbf{r}_B) - V(\mathbf{r}_A) = -\int_{\mathbf{r}_0}^{\mathbf{r}_B} \mathbf{E}\cdot d\boldsymbol{\ell} - \left(-\int_{\mathbf{r}_0}^{\mathbf{r}_A} \mathbf{E}\cdot \right. = -\int_{\mathbf{r}_A}^{\mathbf{r}_B} \mathbf{E}\cdot d\boldsymbol{\ell}$$





Multivibrator circuit

A **multivibrator** is an electronic circuit used to implement a variety of simple two-state[1][2][3] devices such as relaxation oscillators, timers, latches and flip-flops. The first multivibrator circuit, the astable multivibrator oscillator, was invented by Henri Abraham and Eugene Bloch during World War I. It consisted of two vacuum tube amplifiers cross-coupled by a resistor-capacitor network.[4][5] They called their circuit a "multivibrator" because its output waveform was rich in harmonics.[6] A variety of active devices can be used to implement multivibrators that produce similar harmonic-rich wave forms; these include transistors, neon lamps, tunnel diodes and others. Although cross-coupled devices are a common form, single-element multivibrator oscillators are also common. The three types of multivibrator circuits are:

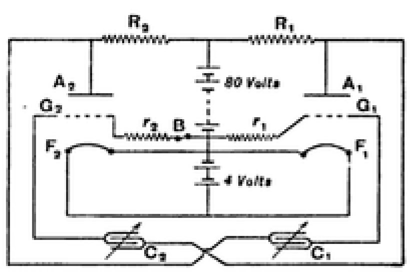


FIG. 8.—Abraham-Bloch Multivibrator.

Original vacuum tube Abraham-Bloch multivibrator oscillator, from their 1919 paper

1. **Astable multivibrator**, in which the circuit is not stable in either state —it continually switches from one state to the other. It functions as a relaxation oscillator.
2. **Monostable multivibrator**, in which one of the states is stable, but the other state is unstable (transient). A trigger pulse causes the circuit to enter the unstable state. After entering the unstable state, the circuit will return to the stable state after a set time. Such a circuit is useful for creating a timing period of fixed duration in response to some external event. This circuit is also known as a **one shot**.
3. **Bistable multivibrator**, in which the circuit is stable in either state. It can be flipped from one state to the other by an external trigger pulse. This circuit

is also known as a flip-flop or latch. It can store one bit of information, and is widely used in digital logic and computer memory.

Multivibrators find applications in a variety of systems where square waves or timed intervals are required. For example, before the advent of low-cost integrated circuits, chains of multivibrators found use as frequency dividers.[citation needed] A free-running multivibrator with a frequency of one-half to one-tenth of the reference frequency would accurately lock to the reference frequency. This technique was used in early electronic organs, to keep notes of different octaves accurately in tune. Other applications included early television systems, where the various line and frame frequencies were kept synchronized by pulses included in the video signal.

CHAPTER FIVE

5.1 EXPERIENCED GAINED

1. I was able to gain a first-hand practical experience in Electrical Electronics Engineering . I leant that good team work is important for fast and good quality job delivery. I also gained knowledge on how to manage personnel on a site.
2. I understood that proper field survey and inventory are pertinent to good quality desk study/work. I also learnt that good supervision produces good quality outcome of work.
3. I learnt that proper project supervision is essential to produce good quality job. I also learnt that good technical, communication and project management skills are important to ensure completion of a project within budget and stipulated time period.
4. I learnt that proper planning and execution are paramount to the success of a project. Also good environmental consideration should be taken.
5. I gained full experience and attract full knowledge of achievement relating to the drainage construction, earthwork and construction of flexible road pavement.

5.2 PROBLEMS ENCOUNTERED

1. Due to the heavy rainfall, there were days whereby petite activities took place, thus limiting work progress on site.
2. The presence of water pipe within the drainage construction area leading to proper planning, coordination, and transferring of the water pipe in small length away from the drain line, leading to delays in the work progress on site.
3. During my first few weeks, I had difficulties understanding a lot of the terms and terminologies that was used at the office because a lot of them were very new to me. This made it hard for me to follow the procedures.

5.4 RECOMMENDATION

In view of the relevance of the SIWES program, it is important that it is sustained by the government through the Industrial Training Fund (ITF) as it exposes the student to work tools, facilities, and equipment that may not be available in their respective institutions in relation to their course of study.

To this end, I recommend that the following under-listed points should be implemented:

1. Students' Industrial Works Experience Scheme (SIWES) needs to be strengthened by all concerned stakeholder in order for its objectives to be fully realized.
2. Regular monthly allowances for students on attachment should be paid promptly.
3. Organizations should always accept students for SIWES and subsequently assign them to relevant jobs.
4. Experience staff should always be made to train the students on attachment
5. There should be more funding of the scheme by the government in order for it to be more effective.
6. The companies should put in place all the necessary facilities needed to enhance the knowledge of the student in industrial attachment.
7. It will be of great benefit if the institution can create a platform whereby student can obtain pre- Siwes knowledge or excursion programs, before student embark for general 4 months industrial training programme.

5.5 CONCLUSION

In road construction, the preliminary stage must involve a reconnaissance survey, the desk study, oral interview for the people around the proposed road.

A detailed survey of the proposed road site must be carried out for a good vertical and horizontal alignments.

The geotechnical and physio technical investigations of the proposed road site must be given full consideration in the road design and in the preparation of the Bill of Engineering Measurement and Evaluation (BEME). The Bill of Engineering Measurement and Evaluation must contain all necessary items of work in the right quantities.

Electrical electronics engineering, thought very wide, is an interesting field of Engineering. Electrical Electronics Engineering practices are easy in as much the technical know-how is acquired. Every task in life possesses some challenges. So, one must be ever ready to face and solve the problems encountered in any tasks for the benefits of mankind and oneself.

Since this programme is of great importance to student under no circumstance. Should the programme be eradicated because it is indeed a great programme enhance student not only academically but also intellectually.