RQF LEVEL 5

TRADE: ELECTRONIC SERVICES

MODULE CODE:ELSPS501

TEACHER'S GUIDE

Module name: DC POWER SUPPLY REPAIR

TABLE Of CONTENTS

Acronyms

AC: Alternating Current

DC: Direct Current

DMM: Digital multimeter

LCD: liquid crystal display

LED: light emitting diode

PPE: Personnel protective equipment

RPE:respiratory protective equipment

RQF: Rwanda Qualification Framework

RTB: Rwanda TVET Board

RVI: Remote visual inspection

TVET: Technical and Vocational Educational and Training

VT: Visual test

Introduction

This module describes the skills, knowledge and attitudes required to repair DC power supply. At the end of this module, participants will be able to identify faults, diagnose and describe, apply fault fixing techniques and document the work process.

A DC power supply is a type of power supply that gives direct current (DC) voltage to power a device. Because DC power supply is commonly used on an engineer‘s or technician‘s bench for a ton of power tests, they are also often called a "bench power supply.

A DC power supply, also known as a bench power supply, is a type of power supply that gives direct current (DC) voltage to power a device. Step down transformation, rectification, DC filtration, and regulation are the four major steps in a regulated DC power supply block diagram.

DC power supply designs are categorized into two types: unregulated power supply and regulated power supply. DC power supplies have four basic outputs: constant voltage, constant current, voltage limit, and current limit. Battery eliminators, constant voltage power supply, constant voltage/constant current power supply, programmable supply, and multi-range power supply are the most common DC power supplies available on the market.

Module Code and Title: ELSPS501 REPAIRING DC POWER SUPPLY

Learning Units:

1. Prepare the dc power supply repairwork
2. Rectify dc power supply faults
3. Document the work done

Learning Unit 1: Prepare the dc power supply repair work

STRUCTURE OF LEARNING UNIT 1

Learning outcomes:

1.1 Select the materials, tools and equipment

1.2 Analyze dc power supply

1.3 Set the working environment

Learning outcome 1.1 Select the materials, Tools and Equipment

Duration: 2hrs

Learning outcome 1 objectives:

By the end of the learning outcome, the trainees will be able to:

1. identify material used to repair dc power supply

2. perform well selection of tools used to repair dc power supply

3. know well equipment used to repair dc power supply

Resources

Equipment	Tools	Materials
✓ DC power supply ✓ Screwdriver machine ✓ Soldering station ✓ Digital Multimeter ✓ Air blowing machine ✓ PPE	➢ **Repairing tools** ✓ Soldering irons ✓ Screwdrivers ✓ Pliers ✓ Cable cutters ✓ Crimping tools ➢ **Cleaning tools** ✓ Brushes ✓ Sponge ✓ Soft cloth	✓ Cables and wires ➢ Repairing materials ✓ Soldering tin ✓ Screws ✓ Electronic ✓ components

Advance preparation:

- Prepare the workplace
- Prepare plan practical exercise related to selection of tools, materials and equipment
- Gather the necessary materials for class usage
- Trainer makes research on Internet

Indicative content1.1.1: Description of tools, materials and equipment.

- **Tools:** a device or implement, especially one held in the hand, used to carry out a particular function.

A tool is any instrument or simple piece of equipment that you hold in your hands and use to do a particular kind of work.

- **Materials:** are the matter or substance that objects are made from.

  A material is a chemical substance or mixture of substances that constitute an object.
- **Equipment:** it is defined as the necessary items for a particular purpose.

Equipment consists of the things, which are used for a particular purpose.

Indicative content1.1.2: Classification of tools and their uses

✓ **Repairing tools**

Soldering irons is a hand tool used in soldering. It supplies heat to melt solder so that it can flow into the joint between two work pieces.

Figure 1: soldering iron

- **Screwdrivers**

A **screwdriver** is a tool, manual or powered, used for screwing (installing) and unscrewing (removing) screws. A typical simple screwdriver has a handle and a shaft, ending in a tip the user puts into the screw head before turning the handle. The shaft is usually made of tough steel to resist bending or twisting.

- **Pliers**

Pliers are a hand tool used to hold objects firmly, possibly developed from tongs used to handle hot metal in Bronze Age Europe. They are also useful for bending and compressing a wide range of materials. Generally, pliers consist of a pair of metal first-class levers joined at a fulcrum positioned closer to one end of the levers, creating short jaws on one side of the fulcrum, and longer handles on the other side.

- **Cable cutters**

Wire and cable cutters are tools that have been designed to properly cut either wire or cable with minimal damage to the insulation or internal conductors of the wire or cable. Having a clean cut on a wire or cable can improve the quality of an electrical connection.

Figure: cutter cable

- **Crimping tools**

What is a Crimp Tool? Crimp tools are a varied collection of devices used to join materials or components by pressing them together and creating a seal or crimp. One of the most common uses of crimping tools is the attachment of connectors to the end of electrical cables

Figure: crimping tools

- ✓ **Cleaning tools**
- **Brushes**

A **brush** is a common tool with bristles, wire or other filaments. It generally consists of a handle or block to which filaments are affixed in either a parallel or perpendicular orientation, depending on the way the brush is to be gripped during use. The material of both the block and bristles or filaments is chosen to withstand hazards of its intended use, such as corrosive chemicals, heat or abrasion. It is used for cleaning, grooming hair, make up, painting, surface finishing and for many other purposes.

Figure: brushe

- **Sponge**

The definition of a sponge is a sea animal that has a skeleton and a porous surface, or an absorbent piece used for washing, or a pad of gauze used in medicine. ... An example of a sponge is what people use to clean the counters. An example of a sponge is what a doctor uses in surgery to clean a wound.

Figure: spoge

- **Soft cloth**

Soft clothing refers to any fabric such as cotton, fleece, silk, satin and so on. It describes fabrics that are soft to feel and soft on the skin. Clothing has evolved into an industry with countless varieties of fabrics that can be designed into a wide range of apparel such as shirts, pants, dresses, jackets and so on.

Figure: soft cloth

Indicative content1.1.3: Classifications of materials and their use

✓ **Cables and wires**

An electrical cable is an assembly of one or more wires running side by side or bundled, which is used to carry electric current. A cable assembly is the composition of one or more electrical cables and their corresponding connectors. A cable assembly is not necessarily suitable for connecting two devices but can be a partial product (e.g. to be soldered onto a printed circuit board with a connector mounted to the housing).

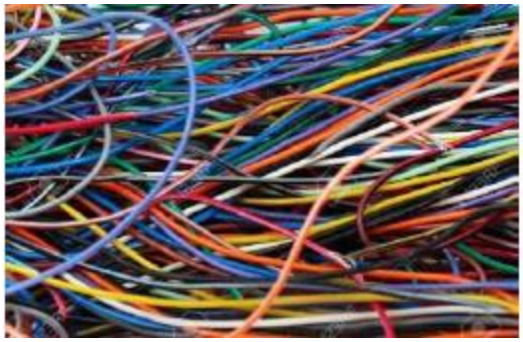


Figure : Cables and wires

✓ **Repairing materials**

- Soldering tin

Solder is a fusible metal alloy used to create a permanent bond between metal work pieces. Solder must first be melted in order to adhere to and connect the pieces together after cooling, which requires that an alloy suitable for use as solder have a lower melting point than the pieces being joined.

Figurer: soldering tin

- **Screws**

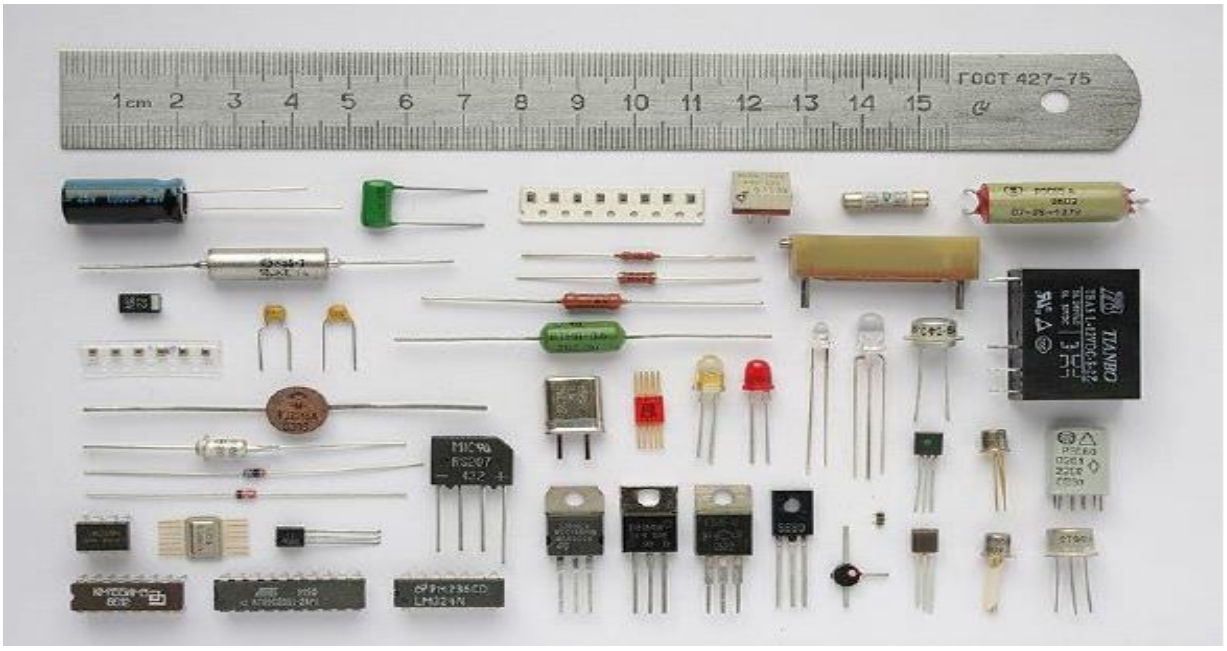
What is screw use?

The two primary functions of a screw are **to hold things together or to lift objects**. The threading around the shaft in a screw makes it an efficient tool to hold things together. The threads grip the surrounding material like teeth, resulting in a secure hold.

- **Electronic Components**

An electronic component is any physical entity in an electronic system used to affect the electrons or their associated fields in a manner consistent with the intended function of the

electronic system. Components are generally intended to be connected together, usually by being soldered to a printed circuit board (PCB), to create an electronic circuit with a particular function (for example an amplifier, radio receiver, or oscillator).Components may be packaged singly, or in more complex groups as integrated circuits. Some common electronic components are capacitors, inductors, resistors, diodes, transistors, etc. Components are often categorized as active (e.g. transistors and thyristor) or passive (e.g. resistors, diodes, inductors and capacitors).



Indicative content 1.1.4: Equipment and their uses

- ✓ **DC power supply**

Definition: A power supply is an electronic circuit designed to provide various ac and dc voltages for equipment operation.

Proper operation of electronic equipment requires a number of source voltages. Low dc voltages are needed to operate ICs and transistors. High voltages are needed to operate CRTs and other devices.

Power Supply Functions

The complete power supply circuit can perform these functions:

1. Step voltages up or step voltages down, by transformer action, to the required ac line voltage.
2. Provide some method of voltage division to meet equipment needs.
3. Change ac voltage to pulsating dc voltage by either half-wave or full-wave rectification.
4. Filter pulsating dc voltage to a pure dc steady voltage for equipment use.
5. Regulate power supply output in proportion to the applied load.

✓ **Screwdriver machine**

Most cordless drills these days are also designed to drive screws, that's why they're called a drill driver. If you've never used yours as a screwdriver or have tried but haven't had much success, here's a complete guide to using your drill to drive screws.

Figure: screwdriver machine

Which bit do I need for screws?

The type of bit you need depends on the shape on the head of the screw. The most common is the star-shaped Phillips head. For this you will need a No. 2 Phillips head driver bit which is the correct size to suit most types of these screws. Other common driver bits you will come across are the internal hex drive for bugle head batten screws; the square drive bit for decking screws and the nut setter hex bit which fits over roofing screws.

Figure: switching screwdriver machine

Which drill speed is best for driving screws?

Low speed gives you the most control over driving screws, especially for the beginner and if you are using Phillips head bits screws, whichdo not lock into the head of a screw as well as other types of bits.

Figure: selection of speed

- ✓ **Soldering station**

A soldering station is a multipurpose power soldering device designed for electronic components soldering. This type of equipment is mostly used in electronics and electrical engineering. Soldering station consists of one or more soldering tools connected to the main unit, which includes the controls (temperature adjustment), means of indication, and may be equipped with an electric transformer. Soldering stations may include some accessories – holders and stands, soldering tip cleaners, etc. Soldering stations are widely used in electronics repair workshops, electronic laboratories, in industry.

Figure: soldering station

The main tools for soldering are:

- contact soldering irons;
- disoldering tweezers or SMD hot tweezers;
- desoldering gun;
- hot air gun;
- infrared heater.

✓ **Digital Multimeter**

We mostly used multimeter is digital multimeter (DMM). The DMM performs all functions from AC to DC other than analog. It has two probes positive and negative indicated with black and red color is shown in figure. The black probe connected to COM JACK and red probe connected by user requirement to measure ohm, volt or amperes. The jack marked VΩ and the **COM** jack on the right of the picture are used for measuring voltages, resistance and for testing a diode. The two jacks are utilized when LCD display that shows what is being measured (volts, ohms, amps, etc.). Overload protection that prevents damage to the meter and the circuit, and protects the user.

Figure: Digital Multimuter

- ✓ **Air blowing machine**

Air blower machine is a simple and effective electrical device used in homes and industries to blow away dust from every nook and corner. For gadgets and electronics have delicate parts that cannot be cleaned with a cloth. This is when you need air blowers to remove dust with its continuous air pressure. This durable and efficient machine save a good amount of time and effort consumed in cleaning and dusting tasks.

Figure: air blower machine

How does air blower work?

An impeller at the center of the air blower sucks air and creates a spiral flow of air thereby creating a dynamic pressure that forces the air to flow through a curved path and out of the

blower. The different speed levels are set for various kinds of cleaning such as cleaning electronic components, leaves shed in the garden area, etc.

Types of air blowers

Depending on the power capacity, design of blades, size, and application, air blowers come in different types as discussed below:

a) Forward-curved

Here the design of the blade is in a curved direction. This creates a higher velocity when rotating a low speed.

b) Backward-curved

Here the blades rotate at a much higher speed as compared to forward-curved blades. The flat blades move away from the direction of rotation. It is best for tasks that require high-static pressure.

c) Airfoil

It has airfoil-shaped blades that gradually curve down to narrow towards the outer end.

d) Radial

Used in small exhaust systems, the blades are not curved and generally used for cooling purposes.

Difference between blower and fan

FAN	**BLOWER**
Electrical device	Mechanical device
Circulate the air all around/in every direction	With impeller, the air is directed in one direction
A large amount of air circulated at a low pressure	With centrifugal force, a large volume of air pushed at a moderate or specified pressure

Factors to consider before buying an air blower

- Opt for battery operated handheld air blowers for small tasks. They can be charged easily and quickly.

- Electric air blowers are best for long hour usage or cleaning of the larger area.
- Always select blowers that are light in weight that consumes lesser energy and can be used for a longer time without tiredness. Lightweight blowers are easy to handle, operate, maintain, and store
- Make use of the noise level is lower. It will not annoy you or others, especially during long-time use.

✓ **Personal protective equipment (PPE)**

PPE is the personal protective equipment that will protect the user against health or safety risks. They can include items such as safety helmets, gloves, eye protection, hazmat suits, high-visibility clothing, safety footwear, safety tie together, ear plugs, ear defenders and respiratory protective equipment (RPE).

Figure : PPE

Types of PPE

Various types of PPE are available for use in the workplace. The Health and Safety Executive provides guidance and general information about types of PPE used in industry, but it doesn't cover specialized and less-used items. Potential users should be involved in the

selection of equipment they will be expected to wear and if possible more than one model should be made available to them.

The different types of PPE include:

- Head protection (helmet)
- Respiratory protection (nose mask)
- Eye protection (googles)
- Hearing protection (earmuff)
- Hand and arm protection (groves)
- Foot and leg protection (boot or safety shoes)
- Body protection (overall or overcoat)

Where PPE is required, it must:

- Be appropriate for the risks and for the working environment;
- Take account of the user's health, ergonomic, physical and other factors adequately control the risk presented by the hazard without increasing overall risk experienced by the worker;
- Be supplied and replaced free of charge;
- Comply with relevant legislation implementing the European Directives concerning the design and manufacture;
- Where reasonably practicable provide a range of PPE to allow workers to choose the equipment that best suits their working environment and routines, but always ensure that the alternatives made available provide the level of protection required;
- Provide training, instruction or information, including refresher training and demonstrations, as appropriate in the use and care of the PPE provided;

- Ensure face fit testing is undertaken for close fitting respiratory protective equipment;

- Establish a system of recording the issue of PPE and of monitoring, examination and repair for PPE and to allow the reporting of missing or lost items

Summary for the trainer related to the indicative content (key notes using bullets such as ticks etc)

- **Tools:** a device or implement, especially one held in the hand, used to carry out a particular function.
- **Materials:** are the matter or substance that objects are made from.
- **Equipment:** is defined as the necessary items for a particular purpose
- Diffirent types of PPE :

- Head protection (helmet)
- Respiratory protection (nose mask)
- Eye protection (googles)
- Hearing protection (earmuff)
- Hand and arm protection (groves)
- Foot and leg protection (boot or safety shoes)
- Body protection (overall or overcoat)

Theoretical learning Activity

1. Identify the some types of tools, material, equipment and their uses.

Answer

tools	materials	equipment

1. Soldering iron 2. Screwdrivers 3. Pliers 4. Cable cutter 5. Crimping tool, etc	1. Soldering tin 2. Screws 3. Electronic components 4. Cables, etc	1. Dc power supply 2. Screwdriver machine 3. Soldering station 4. Digital multimeter 5. PPE, etc

2. Develop the differences between fan and air blower machine**.**

FAN	**BLOWER**
Electrical device	Mechanical device
Circulate the air all around/in every direction	With impeller, the air is directed in one direction
A large amount of air circulated at a low pressure	With centrifugal force, a large volume of air pushed at a moderate or specified pressure

Practical learning Activity

✓ Task for today, you have to select the required tools,material and equipment that can be used for repair dc power supply.

ndicator	SCORE	
	YES	NO
Indicator: tools, materials, and equipment are well described		
✓ Tools		
✓ Materials		
✓ equipment		
Indicator: tools, materials are well classified		
✓ Repairing tools		
✓ Cleaning tools		
✓ Cables		
✓ Wires		

✓ Repairing materials		
Indicator: equipment are well classified		
✓ DC power supply		
✓ Screwdriver machine		
✓ Soldering station		
✓ Digital multimeter		
✓ Air blower machine ✓ PPE		
observation		

 Points to Remember (Take home message)

- Dc power supply: is types of power supply that gives direct current (dc) voltage to power devices.
- Well selection of tools, materials and equipment to be used for DC power supply repair

Learning outcome1.2: Analyse DC power supply specification.

 **Duration: 2hrs**

 **Learning outcome 1 objectives:**

By the end of the learning outcome, the trainees will be able to:

1. identify material used to repair dc power supply

2. perform well selection of tools used to repair dc power supply

3. know well equipment used to repair dc power supply

Resources

Equipment	Tools	Materials
✓ DC power supply ✓ Screwdriver machine ✓ Soldering station ✓ Digital Multimeter ✓ Air blowing machine ✓ PPE	➢ **Repairing tools** ✓ Soldering irons ✓ Screwdrivers ✓ Pliers ✓ Cable cutters ✓ Crimping tools ➢ **Cleaning tools** ✓ Brushes ✓ Sponge ✓ Soft clot	✓ Cables and wires ➢ Repairing materials ✓ Soldering tin ✓ Screws ✓ Electronic ✓ components

✓

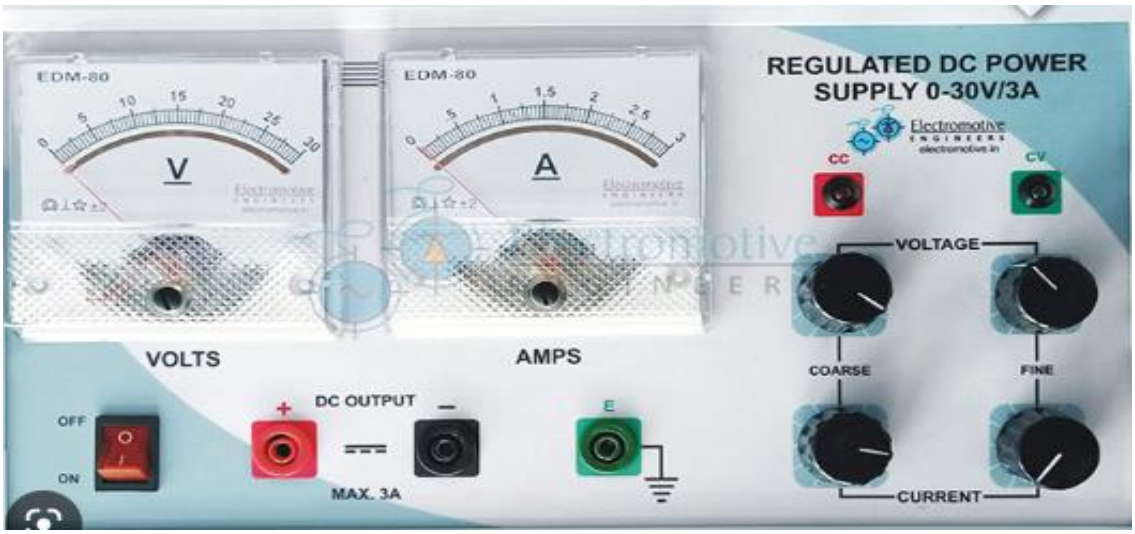
Advance preparation:

- ❖ Prepare the workplace
- ❖ Trainer's make research on Internet
- ❖ Trainer ask the learner's by using brainstorming method
- ❖ Group discussion on types and use of different tools, materials and equipment
- ❖ Demonstration of DC Power supply parts and different types of tools, materials and equipment
- ❖ Workshop available tools, materials, equipment used for repair dc power supply
- ❖ Practical exercises on selection and use of tools, materials and equipment

Indicative content1.2.1: Identification of different types DC Power supply

- ✓ **Variable DC power supply**

A variable DC power supply is a DC power supply that allows the users to easily adjust the output voltage and current via potentiometers or a computer interface. It is also known as an adjustable dc power supply.



- ✓ **Constant voltage DC power supply**

A constant voltage supply provides a constant and adjustable voltage. Its design is much more complex than battery eliminators.

A typical unit has a voltage meter and current meter where you can monitor the voltage and current supply values respectively. Regardless of the load‘s resistance, the voltage is maintained in this type of DC power supply. The output voltage is adjusted using a knob. For some units, the output voltage may not be adjusted down to zero volts. Also, some models do not supply the rated current at any output voltage. In these instances, the maximum output current would be proportional to the output voltage

Figure: constants voltage of dc power supply

Other types of DC power supply

1. **Multiple Output Supply**

As the name suggests, this type of DC power supply provides more than one DC output, usually two or three. Multiple output supplies are cost-effective option systems requiring multiple voltages

Digital Logic where one output provides 0-6V

Bipolar Analog Circuitry

where the other two supply outputs provide 0-20V.

A knob or keypad is placed to set the three outputs independently i.e., turning on and off the outputs can be done separately or all at once. This feature allows a whole printed circuit board to be powered up.A typical unit also has features like:

Output Operation Timer

This allows the user to set a time interval in which the output can turn off automatically after the time set has passed.

Voltage Limit for All Channels

The user can set a voltage limit to avoid accidental over-voltage settings in their prototype electrical design project.

Series or Parallel Connection

A higher voltage or current can be achieved by connecting two volt channels in series or parallel.

Storage Registers

This allows the user to save 50 instrument states for easy recollection of data in repetitive testing.

Last Power-On Settings

In case the AC mains line fails, this type of power supply will restart when the AC power restarts, then provide the same output as the last power-on settings.

Figure: multiple output supply

2. **Programmable Supply**

Programmable supply, often known as system power supplies, are normally integrated into a computer-operated system during production or testing.

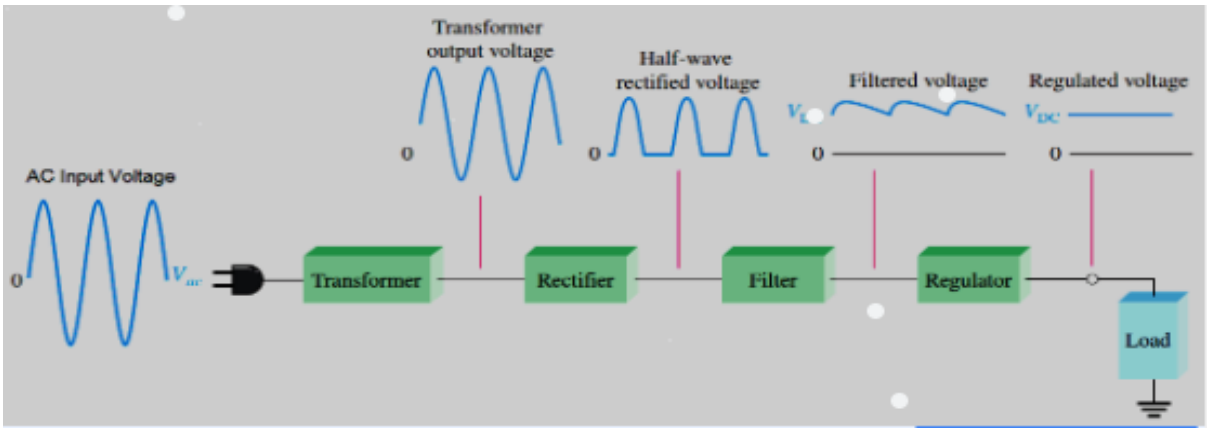
3. **Multi-Range Supply**

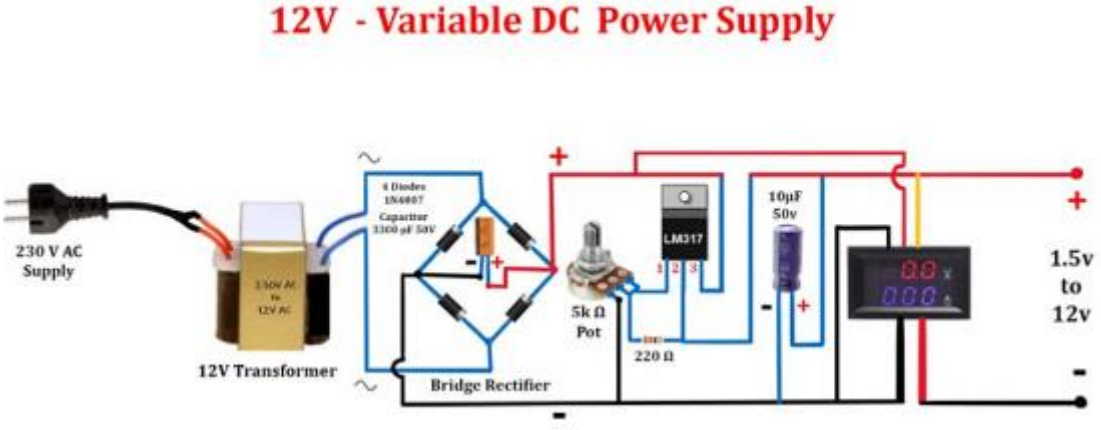
A multi-range DC power supply allows various combinations of voltage and current to operate and still provide maximum power. This is in contrast with most common power supplies that can only provide a maximum output power if operated at a certain fixed voltage and current ratings. Hence, the output power will be less than the maximum if other voltages/current combinations are used in conventional power supplies.

The main advantages of multi-range supply include:

- ✓ Flexibility in output ratings
- ✓ Savings in cost and bench space.

Indicative content1.2.2: Description of main parts of DC Power supply





- ✓ **Transformer:**A transformer is an electrical device that uses the principle of electromagnetic induction to transfer energy from one electric circuit to another. It is designed to either increase or decrease AC voltage between the circuits while maintaining the frequency of the current.

  A transformer is **an inductive electrical device for changing the voltage of alternating current**. A transformer consists of two magnetically coupled coils. Alternating current in one (called the "primary") creates a changing magnetic field which induces a current in the second coil (the "secondary")
- ✓ **Rectifier:** this the device which is used to convert ac voltage to dc voltage . by using p-n junction diode which conduct when forward bias and practically does not conduct when reverse biased and typically need are two or four diodes. Rectifier may be either half wave ,full wave rectifier (center tap or bridge)types.

- ✓ **Filter:** this is device which passes dc components to the load and block ac components of the rectifier out put . filter is typically constructed from reactive components such as capacitor ,inductors, and resistors.

- ✓ **Regulator**: this is the components (apart)of dc power supply that ensures a steady constant voltage supply through all operational conditions.

  It regulated voltage during power fluctuation and variation loads.

Indicative content1.2.3: Identification of technical specifications

- ✓ **Input voltage**: large power supplies may we use three phrase power these can be more economical and a bit more efficient than single phase supply. although the ripple frequencies will be higher so it is necessary to be with input voltage so that your system must be immune to ripple.

- ✓ **Output voltage:** ensure the output specified over the allowed input line voltage range.mas you must think of about is at fixed voltage constants and adjusted highly

to a desired value same power supply move output protection this same times called crow bar the voltage protection.

- ✓ **Constant current and regulation Constant voltage mode**

The most common and versatile regulated dc power supply is the constant current and constant voltage types which as the same implies can provide either a constant current or constant voltage with in certain range .

Regulation all about how much output change for change in input AC voltage

- ✓ **Ripple and noise:** the easiest measurement of ripple and noise is to connect an AC coupled oscilloscope of output of the power supply **.**you must choose the DCpower which has less ripple (noise).
- ✓ **Temperature:** as the components that make up the power supply are temperature sensitive. DC power should have temperature coefficients of under 0.05% per $C^{\underline{0}}$
- ✓ **Tracking accuracy:** some power supply with 2 v or more output may have a tracking feature this is where are output voltage of another output.
- ✓ **Protection:**A way to protect against overvoltage is by using a zener diode. Instead of placing it like a regular diode, position a zener diode across the incoming positive supply and ground in a reversed manner.

Summary for the trainer related to the indicative content (key notes usingbulletssuch as ticksetc)

- **different Types DC Power supply**
- **main parts of DC Power supply**
- **technical specification**

Theoretical learning Activity

- ✓ **choose the correct answer**

1. The following are the types of power supply except:

I. Variable dc power supply

II. Constant voltage dc power supply

III. Rectifier dc power supply

Answer: III.

2. what are the main parts of dc power supply ?

Answer

Transformer, Rectifier, Filter, regulator

(example: ask trainees to brainstorm about……. within groups)

Practical learning Activity

- ✓ As a leaner, you are asked to identify different parts of the faulty DC power supply used in electronic laboratory.

  (Example: Trainees in pair perform ……)

indicator	SCORE	
	YES	NO
Indicator: types of dc power supply are well identified		
✓ variable dc power supply		
✓ constant voltage dc power supply		
Indicator: main parts of dc power supply		
✓ transformer		
✓ rectifier		
✓ filter		
✓ regulator		
Indicator: technical specification of are well identified		
✓ input voltage		
✓ output voltage		
✓ constant current		
✓ ripple and noise		
✓ constant voltage		
✓ temperature		

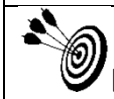
✓ tracking accuracy		
✓ protection		
observation		


Points to Remember (Take home message)

- Block diagram of dc power supply circuit.
- Main parts of dc power supply
- Technical specifications of dc power supply

Learning outcome1.3: Set the working environment


Duration: 1hr


Learning outcome 3 objectives:

By the end of the learning outcome, the trainees will be able to:

1.apply the cleaning techniques of workplace

2. understand well safety rules and guidelines

3. know how to arrange tools, materials and equipment

Resources

Equipment	Tools	Materials
✓ DC power supply ✓ Screwdriver machine ✓ Soldering station ✓ Digital Multimeter ✓ Air blowing machine ✓ PPE	➢ **Repairing tools** ✓ Soldering irons ✓ Screwdrivers ✓ Pliers ✓ Cable cutters ✓ Crimping tools ➢ **Cleaning tools** ✓ Brushes ✓ Sponge ✓ Soft cloth	✓ Cables and wires ➢ Repairing materials ✓ Soldering tin ✓ Screws ✓ Electronic ✓ components

Advance preparation:

- ❖ Prepare the workplace
- ❖ Gather the necessary materials for class usage
- ❖ Trainer makes research on Internet

Indicative content1.3.1: Cleaning techniques

- ✓ **Blowing**

Any vapor or gas issuing from a vent under pressure. or a method of producing hollowware by injecting air under pressure into a fluid mass, as of glass or plastic, and shaping the material within a decay. A "quiet" nozzle (i.e. one with low noise emission) should be

selected. The nozzle pressure must remain below 10 psi (69 or 70 kPa) and personal protection equipment (PPE) must be worn to protect the worker's body, especially the eyes, against particles and dust under pressure.

- ✓ **Brushing**

A **brush** is a common tool with bristles, wire or other filaments. It generally consists of a handle or block to which filaments are affixed in either a parallel or perpendicular orientation, depending on the way the brush is to be gripped during use. The material of both the block and bristles or filaments is chosen to withstand hazards of its intended use, such as corrosive chemicals, heat or abrasion. It is used for cleaning, grooming hair, make up, painting, surface finishing and for many other purposes. It is one of the most basic and versatile tools in use today, and the average household may contain several dozen varieties.

- ✓ **Toweling**

An absorbent cloth or paper for wiping and drying something wet, as one for the hands, face, or body after washing or bathing.

Indicative content1.3.2: Apply safety rules and guidelines

- ✓ **Individual safety precautions**

Safety in the workplace begins with a proper safety plan that is put into place by management and observed by all employees. Safety precautions must be strictly adhered to because if they are not, some employees can put all other employees at risk. Work place accidents translate into days missed for work, reduced productivity, and lost profits. If an employee is seriously injured, they may turn to worker's compensation which ends up costing the business money in increased premiums. Also, morale among employees can suffer because they are concerned about their safety and ability to work in an environment where other employees have suffered an injury.

- ✓ **Electrical safety precautions**

All personnel must know and observe general safety precautions. Those who perform particular duties or operations must know and observe the safety precautions for those duties or operations. Those who don't understand safety precautions, and those who ignore

them, are equally at risk of injury that may end in disablement or death. Therefore, all supervisory personnel must emphasize safety as part of their daily supervisory duties. This is especially important during the training of new personnel when they are forming good or bad habits.

These are some operating precautions can be made in different activities to assure best safety operation precautions:

1. Never make any adjustments while the machine is operating.
2. Do not support the workplaces by hand. Use a holding device to prevent the work piece from being tom from the operator's hand.
3. Never clean away chips with your hand. Use a brush.
4. Keep all loose clothing away from turning tools.
5. Make sure that the cutting tools are running straight before starting the operation.
6. Never place tools or equipment on the drilling tables.
7. Keep all guards in place while operating.
8. Ease up on the feed as the drill breaks through the work to avoid damaged tools or workplaces.
9. Remove all chuck keys and wrenches before operating.
10. Always wear eye protection while operating any drilling machines.

- ✓ **Operating safety precautions**

It's vitally important to take safety precautions when working with electricity. Safety must not be compromised and some ground rules need to be followed first. The basic guidelines regarding the safe handling of electricity documented below will help you while working with electricity.

1. Avoid water at all times when working with electricity. Never touch or try repairing any electrical equipment or circuits with wet hands. It increases the conductivity of the electric current.
2. Never use equipment with frayed cords, damaged insulation or broken plugs.

3. Always use insulated tools while working.
4. Electrical hazards include exposed energized parts and unguarded electrical equipment which may become energized unexpectedly. Such equipment always carries warning signs like “Shock Risk”. Always be observant of such signs and follow the safety rules established by the electrical code followed by the country you are in.

Indicative content1.3.3: Techniques of arranging tools, materials and equipment

Introduction: Organization or arrangement of tools, materials and equipment is one of the keys to an effective workplace. It seems like such a simple thing, but the fact is that when we take the time to organize our workplace, we become more efficient. One reason for this increase in efficiency is the decrease in "search time" that results from an organized work area.

Arrangement is an act of arranging; state of being arranged,the manner or way in which things are arranged.

It is achieved by the following settings:

- ✓ **Arrangement by uses:** the tools, materials and equipment of the same function are put on the same level.

- ✓ **Arrangement by size:** the tools, materials and equipment of the same size, weight are put on the same level.

- ✓ **Arrangement by types:** the tools, materials and equipment of the same type are put on the same level.

✓ **Arrangement by type, uses and size or weight**

Hand tools, a tool in numerically (digitally) controlled machines is composed of several parts, such as the cutting tool (which may be one piece or comprise a body plus index able inserts), a collect, and a tool holder with a machine taper.

- **Purpose arranged material and equipments and tools**

1. Putting the parts together accurately into an assembly is required to achieve error-free production.
2. Logistics deals with demand planning, supplies and tool location.
3. This includes, on one hand, the location in the warehouse and the purchasing of individual parts with the corresponding consumption report.
4. It also allows for the planning and coordination of the movements of the assemblies within the shop floor.

Figure: arranged material and tools, equipments

Theoretical learning Activity

- For the statements below, answer by true or false.

  i. it is not necessary to wear eye protection while operating any drilling machines. **false**

  ii. it is advised to place tools or equipment on the drilling tables. **false**

  iii. cleaning techniques take place while preparing the workplace. **true**

  (Example: ask trainees to brainstorm about……. within groups)

- identify the arranging techniques

  Answer

- arranging by type
- arranging by size
- arranging by use

Practical learning Activity

According to the repair task that you have to curry out, you are asked to arrange (tools, materials, and equipment) and clean the workplace respectively to arranging and cleaning techniques, and respecting all precaution rules

(Example: Trainees in pair perform ……)

indicator	SCORE	
	YES	NO
Indicator: cleaning techniques are well identified		
✓ blowing		
✓ brushing		
✓ towering		
Indicator: safety rules are well described		
✓ individual safety precautions		
✓ electrical safety precautions		
✓ operating safety precautions		
Indicator: tool, materials and equipment are well identified and arranged (knowledge and skill)		
✓ arrangement by types		
✓ arrangement by size		
✓ arrangement by uses		
observation		

Points to Remember (Take home message)

Method for cleaning techniques:

1. Blowing
2. Towelling
3. brushes

arranging techniques of tools, materials, and equipment

1. arranging by size
2. arranging by type
3. arranging by use

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Learning unit 2: Rectify Dc Power Supply Faults

Learning outcomes:

Learning Outcomes

2.1 Check power supply defective parts

2.2 Fix the DC power supply faulty components

2.3 Test the DC power supply

Learning outcome 2.1 Check power supply defective parts

Duration: 7hrs

Learning outcome 4 objectives:

By the end of the learning outcome, the trainees will be able to:

1. perform disassembling and assembling processes of dc power supply

2. understanding well checking method

3. identify different faults of dc power supply

Resources

Equipment	Tools	Materials
✓ DC power supply ✓ Screwdriver machine ✓ Soldering station ✓ Digital Multimeter ✓ Air blowing machine ✓ PPE	➢ **Repairing tools** ✓ Soldering irons ✓ Screwdrivers ✓ Pliers ✓ Cable cutters ✓ Crimping tools ➢ **Cleaning tools** ✓ Brushes ✓ Sponge ✓ Soft cloth	✓ Cables and wires ✓ Soldering tin ✓ Screws ✓ Electronic ✓ components

Advance preparation:

- ❖ research on dc power supply common fault
- ❖ Gather the necessary materials for class usage.
- ❖ Review the teacher guide before teaching, and identify opportunities for instruction support during activities and demonstration.
- ❖ Prepare plan of practical exercise related with checking dc power supply fault

Indicative content2.1.1 **DC power supply disassembling process**

Disassembling: It is process of separating the different parts of device.

Disassembly is a reversal process in which a product is separated into its components and/or subassemblies by non-destructive or semi-destructive operations which only damage the connectors/fasteners.

Steps to be followed:

- Turn off a DC power supply
- Disconnect a power cable from an AC power source
- Unscrewing the screws from the cover of DC power supply
- Remove the caver carefully
- Remove the internal part if is necessary
- Inspect or check the parts you need to get information about them

Indicative content2.1.2: Identification of DC power supply common faults

- ✓ **Transformer fault**

A transformer is device which helps in the transmission of electrical power by step-up or step down(voltage) the electrical power according to the needed by load. the transformers faults are:

- **Over heating fault**:

Over heating faults is caused due to over loads short circuit and in case of failure of the cooling system . over heating is also caused by transformer operated at its maximum potential like high frequency or high voltage then the core will got excited. The temperature indicators can be used to show the level of transformer's operating temperature and temperature relays used to interrupt transformer when the temperature are exceed the transformers temperature rating.

- **Winding fault:** the winding faults is internal faults of transformer if the winding insulation is weak there is a possibility of earth faults and phase-phase faults for 3-phases transformers.
- **Open circuit faults**: an open circuit in phase is the one cause the heating of transformer. Compare to other faults open circuit is harmless during such faults transformer can be manually disconnected form the system.
- **Over fluxing faults**: over fluxing can be caused by poor regulation of voltage and frequency of the power system V/F relay are provided to give protection against over fluxing.
- **Core faults:** the core faults can be used by breakdown in the insulation between the silicon steel cores. This fault is bad because it affect the performance of transformer and is prevented early stage by doing the oil analysis.
- **Cooling failure** :in order to operate the transformer at the full rating ,the cooling system must work properly, must smaller transformer are naturally cooled but large transformer have forced cooling by use of freezer.

- ✓ **Rectifier fault**

The potential faults of the rectifier can be divided into short –circuit and open –circuit faults in an open circuit faults the output voltage would be disturbed according to the certain output.

Ex: when D1 and D2 are considered as open circuit the output voltage would be distorted in the half period of voltage.

The short circuit fault a very harmful to the rectifier system it should protected by using fuse.

- ✓ **Filter circuit fault**

This fault can be caused by capacitor connected wrongly in the case of reverse connection,the capacitor will not work at all.

If the voltage applied to the capacitor is higher than the value of capacitor rating could result an explosion. We know that capacitor may stores the amount of energy an internal failure of one capacitor result an explosion.

How to protect a filter faults

Do not reverse the polarities of components used in filtering system.

Apply the voltage compatible with filter's components rating

- ✓ **Regulation fault**

The load has no output voltage or the load voltage cannot be increase:

i. check the power supply
ii. Check the load whether the load is open or there is a problem with wiring
iii. Check the input signal to the regulator whether the polarity should be reversed.

- ✓ **Ventilation fault**

Failureto maintain proper temperature humidity and air movement in a system may emit air that is uncomfortably for the system. carefully,considerthe location or place where the ventilation device is able for air movement in properly way.

Indicative content2.1.3: Checking methods

- ✓ **Visual checking**

Visual Inspection, or Visual Testing (VT), is the oldest and most basic method of inspection. It is the process of looking over a piece of equipment using the naked eye to look for flaws. It requires no equipment except the naked eye of a trained inspector. Visual inspection is simple and less technologically advanced compared to other methods.

Visual inspection is a technique for detecting defects using the naked eye to ensure equipment is working properly or that manufactured products are being made to specification. This can include visual inspections done in person or remotely using digital images.

Visual inspection methods

- **Random sampling.** Quality checks areperformed on randomly selected products or physical assets. In manufacturing, products are often checked right at the production line for obvious visual defects.
- **Full manual sampling.** A person trained to identify defects inspects all products manually. This can be a physically demanding job with repetitive actions that should be accompanied with safety policies, ergonomic equipment and appropriate tools.
- **Remote visual inspection (RVI).** Using remote cameras, edge technology and drones, organizations can observe equipment safely from afar. This inspection solution may be conducted in real-time; or in remote areas where connectivity may be an issue, the inspections can be performed by retrieving the images and analyzing them later.
- **Automated visual inspection**: Products are inspected in real-time using cameras, image processing methods, and machine learning algorithms. Unlike RVI where teams take inspection equipment into the field, automated visual inspections are typically done onsite in one location.

Figure: visual inspection

✓ **Measuring**

Measurement is the process of using a device or tool to find the dimensions, time, pressure, amount, weight or mass of an object. We use measurements to help us solve problems in many real world situations. There are many types of test instruments used for troubleshooting. Some are specialized instruments, designed to measure various behaviors of specific equipment. There are other types of instruments, such as multimeters, that are

more general in nature and can be used on most electrical equipment. A typical multimeter can measure AC and DC voltages, resistance and current.

- **Voltmeter**: A voltmeter is used to test the differences in voltage between two points.
- **Ohmmeter:** An ohmmeter is used to measure the resistance between two points in a circuit.
- **Ammeter:** An ammeter is an instrument for measuring the current flowing in a circuit in amperes.
- **Multimeter**: A multimeter can test voltage, resistance and current. It is an ohmmeter, voltmeter and ammeter all in one.

- **General Meter Rules**

1. Before you perform a test, you should know what the meter should read if the circuit is operating normally.
2. You should make your prediction based on a circuit diagram. If the reading is anything other than your predicted value, you know that this part of the circuit is being affected by the electrical fault.
3. You should always test the meter before using it to troubleshoot.

For a voltmeter, test the meter on a known voltage source before using. Your meter should read the correct voltage.

For an ohmmeter, touch the meter leads together. The display should read 0 ohms, or very close to 0. With the leads apart it should read OL (infinity)

 Summary for the trainer related to the indicative content (key notes usingbulletssuch as ticksetc)

Steps to be followed for disassembling process

- Turn off a DC power supply
- Disconnect a power cable from an AC power source
- Unscrewing the screws from the cover of DC power supply
- Remove the caver carefully

- Remove the internal part if is necessary
- Inspect or check the parts you need to get information about them

 Theoretical learning Activity

1. rearrange the steps dc power supply disassembling ?

- Turn off a DC power supply
- Remove the caver carefully
- Disconnect a power cable from an AC power source
- Inspect or check the parts you need to get information about them
- Unscrewing the screws from the cover of DC power supply
- Remove the internal part if is necessary

Answer:

- Turn off a DC power supply
- Disconnect a power cable from an AC power source
- Unscrewing the screws from the cover of DC power supply
- Remove the caver carefully
- Remove the internal part if is necessary
- Inspect or check the parts you need to get information about them

2. what do you understand by visual inspection?

Answer:

Visual Inspection, or Visual Testing (VT), is the oldest and most basic method of inspection. It is the process of looking over a piece of equipment using the naked eye to look for flaws. It requires no equipment except the naked eye of a trained inspector.

(example: ask trainees to brainstorm about……. within groups)

 **Practical learning Activity**

✓ Make the disassembling of a dc power supply and start to check whether is faulty or not.

(Example: Trainees in pair perform ……)

indicator	SCORE	
	YES	NO
Indicator: DC power supply disassembling process is well applied		
✓ Remove cover		
✓ Transformer removal		
✓ Rectifier removed		
✓ Filter circuit removal		
✓ Regulator removal		
✓ Cooling system removal		
✓ The user manual steps are followed		
Indicator: DC power supply common faults are well identified		
✓ Transformer fault		
✓ Rectifier fault		
✓ Filter circuit fault		
✓ Regulator fault		
✓ Cooling fault		
Indicator: checking methods are well applied		
✓ visual		
✓ measuring		
observation		


Points to Remember (Take home message)

- Fault identification of dc power supply
- Disassembling process of a DC power supply
- Checking methods

Learning outcome2.2: Fix Power supply faulty components

Duration: 7hrs

Learning outcome 5 objectives:

By the end of the learning outcome, the trainees will be able to:

1. troubleshooting or fixing a dc power supply faults

2. understand all procedures of dc power supply assembling

3. identify different faults of dc power supply at different stages

Resources

Equipment	Tools	Materials
✓ DC power supply ✓ Screwdriver machine ✓ Soldering station ✓ Digital Multimeter ✓ Air blowing machine ✓ PPE ✓ Computer ✓ projector	➢ **Repairing tools** ✓ Soldering irons ✓ Screwdrivers ✓ Pliers ✓ Cable cutters ✓ Crimping tools ➢ **Cleaning tools** ✓ Brushes ✓ Sponge ✓ Soft cloth ➢ Teaching tools ✓ White/black board	✓ Cables and wires ✓ Soldering tin ✓ Screws ✓ Electronic ✓ Components ✓ Internet ✓ Makers ✓ chalks

Advance preparation:

- ❖ prepare practical exercises regarding fault fixing techniques
- ❖ Gather the necessary materials for class usage.

- ❖ Availability of enough workplace
- ❖ Review the teacher guide before teaching, and identify opportunities for instruction support during activities and demonstration.
- ❖ Check that trainees are observing proper wearing any necessary safety ppe

Indicative content2.2.1 Fixing DC power supply faults techniques

✓ **Disoldering and Soldering faulty part**

❖ **Solder:** Turning to the actual techniques of soldering, firstly it is best to secure the work somehow so that it doesn't move during soldering and affect your accuracy. In the case of a printed circuit board, various holding frames are fairly popular especially with densely populated boards: the idea is to insert all the parts on one side ("stuffing the board"), hold them in place with a special foam pad to prevent them falling out, turn the board over and then snip off the wires with cutters before making the joints.

❖ **Desoldering Methods:** A soldered joint which is improperly made, will be electrically "noisy", unreliable and is likely to get worse in time. It may even not have made any electrical connection at all, or could work initially and then cause the equipment to fail later! It can be hard to judge the quality of a solder joint purely by appearances, because you cannot say how the joint actually formed on the inside, but by following the guidelines there is no reason why you should not obtain perfect results.

✓ **Replacement of defective components**

A method of replacing a defective electronic component having a plurality of electrical leads bonded to electrical contacts on a support by cutting leads adjacent the bond site, rebounding the stubs to the contacts, replacing the defective component and bonding the leads of the replacement component to the electrical contacts. Preferably, the leads are cut simultaneously with the rebounding of the stubs. The leads may be bonded to the top of the stub or to the side of the stub. A bonding tool is provided for simultaneously cutting a lead and rebounding the resultant stub.

✓ **Removing the short circuit**

Short Circuits. In electrical devices, short circuits are usually caused by a breakdown in a wire's insulation or when another conductor is introduced and causes the electricity to flow in an unintended way. To fix this problem, you will need to replace the wire.

Locate the wires in your device that are causing the short. Remove the wire by using a soldering gun to melt the solder holding the wire to the contact point and pulling the wire free.

✓ **Removing the open circuit**

Remember that wherever an open circuit exists, although voltage may be present there will be no current flow through the open circuit section of the circuit. Also, as Power (P) is V x I and the current (I) = 0, no power will be dissipated. Looking further at the simple circuit used in Resistors & Circuits Module. Let´s put some actual voltages and currents in and see what happens under 'Open Circuit' conditions. To select a number of open circuit conditions that might occur in different parts of the circuit. Notice how the voltages and currents around the circuit change depending on where the break in the circuit (the open circuit) occurs. Checking the voltages around a circuit with a voltmeter, and noticing where they differ from what would be expected in a correctly working circuit, is one of the main techniques used for tracing a fault in any circuit.

- The current is supplied to the circuit by the battery (E) is divided into two currents I1 flowing through R1 and I2 flowing through R2 and R3.
- Because R2 and R3 are connected in series, the same current (I2) flows through both resistors.
- Both branches of the circuit (R1 and R2/R3 have the same resistance in this circuit (150Ω, commonly shown in circuit diagrams as 150R).

Therefore, half of the 40mA supply current (20mA) flows through each 150Ω branch of the circuit, causing the shown voltages to be developed across each resistor.

Indicative content2.2.2 assembling the DC power supply ports

Assembling : An assembly process utilizes machines, equipment, and/or workers to assemble parts and materials in a pre-defined sequence until there is a finished product.

DC Power supply assembling processes **are**

1. Read the user manual
2. Install the cooling system
3. Fix a voltage regulator, filter and rectifier circuits
4. Fixing of transformer
5. Put the cover

 Summary for the trainer related to the indicative content (key notes usingbulletssuch as ticksetc)

- Soldering methods and procedures
- Disoldering of defective components
- Replacing the defective components

 Theoretical learning Activity

1. Organize the steps to follow when assembling a dc power supply.

- Read the user manual
- Put the cover
- Install the cooling system
- Fixing of transformer
- Fix a voltage regulator, filter and rectifier circuits

Answer

- Read the user manual
- Install the cooling system
- Fix a voltage regulator, filter and rectifier circuits
- Fixing of transformer
- Put the cover

2. Identify the techniques for fixing the dc power supply faults.

answer

- Disoldering

- Replace faulty component
- Removal of short/open circuit
- Solder the new component

(example: ask trainees to brainstorm about……. within groups)

Practical learning Activity

✓ Fix the dc power supply voltage regulator IC which is faulty by using a new voltage regulator IC.

(Example: Trainees in pair perform ……)

indicator	SCORE	
	YES	NO
Indicator: DC power supply faults fixing techniques are well applied		
✓ disoldering		
✓ replace faulty component		
✓ remove short/open circuit		
✓ soldering		
Indicator: DC power supply parts are well assembled		
✓ Transformer		
✓ Rectifier		
✓ Filter circuit		
✓ Regulator		
✓ Cooling system		
✓ cover		
observation		

Points to Remember (Take home message)

- Method used for faults fixing techniques of dc power supply
- Assembling procedures of dc power supply

Learning outcome2.3: Test the DC power supply

Duration: 6hrs

Learning outcome 6 objectives:

By the end of the learning outcome, the trainees will be able to:

1. apply the testing techniques

2. perform cold and hot testing methods

3. understanding well the use of measuring equipment

Resources

Equipment	Tools	Materials
✓ DC power supply ✓ Screwdriver machine ✓ Soldering station ✓ Digital Multimeter ✓ Air blowing machine ✓ PPE	➢ **Repairing tools** ✓ Soldering irons ✓ Screwdrivers ✓ Pliers ✓ Cable cutters ✓ Crimping tools ➢ **Cleaning tools** ✓ Brushes ✓ Sponge ✓ Soft cloth	✓ Cables and wires ✓ Soldering tin ✓ Screws ✓ Electronic ✓ components

Advance preparation:

- ❖ prepare Practical exercises on DC power supply testing techniques
- ❖ Gather the necessary materials for class usage.

- ❖ Availability of enough devices for measuring
- ❖ Prepare the measurement equipment

Indicative content 2.3.1 applying testing techniques

- ✓ **Continuity testing**

In electronics, a **continuity test** is the checking of an electric circuit to see if current flows (that it is in fact a complete circuit). A continuity test is performed by placing a small voltage (wired in series with an LED or noise-producing component such as a piezoelectric speaker) across the chosen path. If electron flow is inhibited by broken conductors, damaged components, or excessive resistance, the circuit is "open".

Continuity tests measure if electricity can flow through the part.

Plug the two probes into the multimeter and set the dial to 'continuity.' If you place the red and black probes on either side of the part (some parts have diodes and are one-directional so you need to arrange the probes accordingly), and you get a read of approximately zero, electricity can flow through the part. If it can't, your multimeter will go towards one or displays OL for open loop. The question is whether electricity is supposed to flow through or not.

Test continuity with a Digital Multimeter, follow the following steps:

1. Adjust the dial to the meter continuity (the little speaker) function.

2. Plug the test leads into the suitable terminal.

3. Touch the component under test using the leads

The DMM beeps under good continuity that allows the flow of current. If no continuity exists, the DMM does not beep.

- ✓ **Voltage measurement**

Instruments for measuring voltages include the voltmeter, the potentiometer, and the oscilloscope. Analog voltmeters, such as moving-coil instruments, work by measuring the current through a fixed resistor, which, according to Ohm's Law, is proportional to the voltage across the resistor. The potentiometer works by balancing the unknown voltage against a known voltage in a bridge circuit. The cathode-ray oscilloscope works by amplifying the voltage and using it to deflect an electron beam from a straight path, so that the deflection of the beam is proportional to the voltage. To measure voltage is to determine the "differential" voltage between two separate points in an electrical circuit.

Follow the following steps for Measuring Voltage:

To start, let's measure voltage on a AA battery: Plug the black probe into COM and the red probe into mAVΩ. Set the multimeter to "V" in the DC (direct current) range. Almost all portable electronics use direct current), not alternating current. Connect the black probe to the battery's ground or '-' and the red probe to power or '+'.

- ✓ **Current measurement**

Current can be measured using an ammeter. Electric current can be directly measured with a galvanometer, but this method involves breaking the electrical circuit, which is sometimes inconvenient. Current can also be measured without breaking the circuit by detecting the magnetic field associated with the current. There are two main ways to measure current one is based on electromagnetics and is associated with the early moving coil (d'Arsonval) meter, and the other is based on the main theory of electricity, Ohm's law.

- ✓ **Electronic components testing**

Once you have the component out of the appliance, you're ready to use the multi-meter. These devices test a lot of things, and the most common are continuity, voltage, and resistance:

Resistance tests how much current is lost as electricity flows through a component or circuit.

It's measured in ohms, and it is slightly more complicated to test than continuity. Whereas continuity works on a range of zero to one (or OL), resistance can come in different strengths so you need to know how much resistance a given part *should* have. Then you'd manually set the range on your multimeter around that amount so the multimeter can provide a readout of if the resistance is lower or higher than that amount.

- ✓ **Functionality of DC power supply**

It is a type of software testing which is used to verify the functionality of the software application, whether the function is working according to the requirement specification. In functional testing, each function tested by giving the value, determining the output, and verifying the actual output with the expected value.

Functional testing performed as black-box testing which is presented to confirm that the functionality of an application or system behaves as we are expecting. It is done to verify the functionality of the application.

Functional testing also called as black-box testing, because it focuses on application specification rather than actual code. Tester has to test only the program rather than the system

Advantages of functional testing are:

a. It produces a defect-free product.
b. It ensures that the customer is satisfied.
c. It ensures that all requirements met.
d. It ensures the proper working of all the functionality of an application/software/product.
e. It ensures that the software/ product work as expected.
f. It ensures security and safety.
g. It improves the quality of the product.

Disadvantages of functional testing are:

a. Functional testing can miss a critical and logical error in the system.
b. This testing is not a guarantee of the software to go live.

The possibility of conducting redundant testing is high in functional testing (R.A., 2002))

Summary for the trainer related to the indicative content (key notes using bullets such as ticks etc)

Test techniques :

- Continuity test
- Measuring test
- Functionality test

 Theoretical learning Activity

1. Fill in the blank space with the appropriate technical term among the listed below:

(Ammeter, resistance, voltage)

I. The amount of charges following in electrical circuit is measured with a help of……..
II. The property of any material to oppose to the current flow is known as ……..
III. The potential difference between two points is known as ……

Answer

i. ammeter
ii. Resistance
iii. Voltage

2.are the following statement true or false?

I. The cold testing method is testing performed while the device is supplied. **false**
II. The hot testing method is testing performed while the device is not supplied. **false**

 Practical learning Activity

✓ By using a digital multimeter, you as a technician you have a task of testing all the voltages at different points of a repaired dc power supply.

(Example: Trainees in pair perform ……)

indicator	SCORE	
	YES	NO

Indicator: testing techniques are well applied		
✓ Continuity testing		
✓ Voltage measurement		
✓ Current measurement		
✓ Test for open /short circuit		
✓ Functionality testing		
observation		

 Points to Remember (Take home message)

Keep in your mind all testing techniques that will help you to test the device after repairing dc power supply by using digital multimeter, such as:

- Voltage test
- Current test
- continuity test
- functionality test

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Learning Unit 3: Document the work done

Learning outcomes:

3.1. Review the previous work

3.2. Record the work process

3.3. Write technical recommendation

Learning outcome3.1: Review the previous work document

Duration: 2hrs

Learning outcome 7 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Identify the elements of work documents

2. prepare the work documents

3. analysis of work document according to the previous work

Resources

Equipment	Tools	Materials
Computer Projector	Board	▪ Markers ▪ Chalks ▪ Pen ▪ Internet ▪ Flip charts ▪ Books ▪ papers

Advance preparation:

- ❖ Gather the necessary materials for class usage.
- ❖ Workplace enough(class available)
- ❖ Review the teacher guide before teaching, and identify opportunities for instruction support during activities and demonstration.

Indicative content 3.1.1 Description of work document elements

- ✓ **Repairing date**

This is the date provided on the report about work carry out. This date will be used to identify how a device experience fault either according to long-life or fault caused by operator have lack of skills on the device.

- ✓ **Addresses of technician**

Location where the technician company carry out their daily activity. When you have a device experienced with fault you can visit the technician in that location and ask help to fix the problem of your devices. This address of technician includes: house number, road address, telephone number, company name, email address etc….

- ✓ **Status of the device**

After receiving the device, you have to check every part of that device to identify the part experienced problem. Then write the behaviors of that device for further maintenance.

- ✓ **Name of the repaired parts**

After repairing the device show its part had problem in order to increase the measurement on recommendation councils and how they can take care on that part of that device.

- ✓ **Work carried out**

Show how you fix the problem, show also the techniques used to identify the problem and fix it.

Provide also tools, equipment and materials used to fix that problem of a device.

- ✓ **Recommendation**

Give advice according to work carry out and fault identified, for future faults prevention. Simple deal with the rules and regulation you can take in order to avoid many faults for our devices.

Indicative content3.1.2: Analysis of the previous work document

- ✓ **Previous faults**

Before starting repairing activities, first review the previous report to identify the faults of that devices. The repair according to the previous report if there is no relation with the previous faults. And help the technicians to identify faults easier.

- ✓ **Previous used Techniques**

Review the previous techniques used to fix the problem. If it can be possible to reuse you can go ahead. Else, apply another technique to fix the present faults.

- ✓ **Previous status of the devices**

Review the status of the device before it experienced with a problem, and determine how a device being affected or crushed.

- ✓ **Previous recommendation**

Review the previous recommendation to identify if the advice they had given were respected else they have to replace some part for better performance.

 Summary for the trainer related to the indicative content (key notes using bullets such as ticks etc)

Works DocumentElement :

- Repairing date
- Addresses of technician
- Status of DC Power supply parts
- Name of the repaired parts
- Work carried out
- Recommendation

 Theoretical learning Activity

1. What are the elements of work documents?

Answer:

- Repairing date
- Addresses of technician
- Status of DC Power supplyparts
- Name of the repaired parts
- Work carried out
- Recommendation

2. Choose the importance of recommendation after repairing dc power supply among the listed below.

  - To prevent future faults
  - To avoid many faults for our devices.
  - To increase the output voltage
  - To minimize the cost

Answer:

  - To prevent future faults
  - To avoid many faults for our devices.

(example: ask trainees to brainstorm about……. within groups)

Practical learning Activity

- ✓ After repairing dc power supply, write down the technical repair report (Example: Trainees in pair perform ……)

indicator	SCORE	
	YES	NO
Indicator: work document elements are well described		
✓ Repairing date		
✓ Addresses of technician		
✓ Status of DC power supply parts		
✓ Work carried out		
✓ Name of the repaired parts		
✓ recommendation		
Indicator: previous work document is well interpreted		
✓ previous faults		
✓ previous used techniques		
✓ previous status of the DC power		
✓ previous previous recommendation		
observation		

Points to Remember (Take home message)

Elements of work documents alphabets

- Repairing date
- Addresses of technician
- Status of DC Power supply parts
- Name of the repaired parts
- Work carried out
- Recommendation

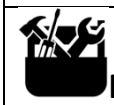
Learning outcome 3.2: Record the work process

 **Duration: 1hrs**

 **Learning outcome 8 objectives:**

By the end of the learning outcome, the trainees will be able to:

1. describe the work carried out

 **Resources**

Equipment	Tools	Materials
Computer Projector	Board	▪ Markers ▪ Chalks ▪ Pen ▪ Internet

 **Advance preparation:**

- ❖ Gather the necessary materials for class usage.
- ❖ Working place enough(class available)
- ❖ Review the teacher guide before teaching, and identify opportunities for instruction support during activities and demonstration.

Indicative content 3.2.1 Description of the work carried out

Faulty parts: show the part of the device have a problem

Type of fault: identify the type of fault either hardware or software

Tools, materials and Equipment used: identify all requirement to fix fault well.

Steps and Techniques used to fix the fault: show clearly the ways for fixing the faults on device.

Status of the device after work: compare the status of device before repair and the status of device after repair to know if the problem is fixed well.

Summary for the trainer related to the indicative content (key notes using bullets such as ticks etc)

Work carried out are included with the following elements :

a. Fault parts
b. Types of fault
c. Tools ,material and equipments used
d. Steps and techniques used to fix the fault
e. Status of the device after work

Theoretical learning Activity

- ✓ **Explain the work carried out process**(example: ask trainees to brainstorm about……. within groups)

Practical learning Activity

- ✓ **Effectively, record all the necessary work process according to the repaired dc power supply.**

  (Example: Trainees in pair perform ……)

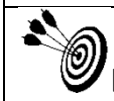
indicator	SCORE	
	YES	NO
Indicator: work document elements are well described		
✓ Repairing date		
✓ Addresses of technician		
✓ Status of DC power supply parts		
✓ Work carried out		
✓ Name of the repaired parts		
✓ recommendation		
Indicator: previous work document is well interpreted		
✓ fixed fault		
✓ tools, materials and equipment used		
✓ steps and techniques used to fix the fault		
observation		

Points to Remember (Take home message)

a. Fault parts
b. Types of fault
c. Tools ,material and equipments used
d. Steps and techniques used to fix the fault
e. Status of the device after work

Learning Outcome 3.3: Write technical recommendation

Duration: 5hrs



Learning outcome 9 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Identify the elements of work documents

2. prepare the work documents

3. Explain the work carried out

Resources

Equipment	Tools	Materials
Computer Projector	Board	▪ Markers ▪ Chalks ▪ Pen ▪ Internet

Advance preparation:

- ❖ Gather the necessary materials for class usage.
- ❖ Working place enough(class available)
- ❖ Review the teacher guide before teaching, and identify opportunities for instruction support during activities and demonstration.

Indicative content 3.3.1 Description of element of technical recommandation

- ✓ **Propose preventive strategies**

Suggesting the way to prevent future faults. Preventive maintenance aims at keeping the equipment in good operating conditions and reliable in order to avoid any breakdown Consists in inspecting, controlling and preserving the equipment by cleaning, adjusting and also replacing pieces when estimated necessary.

The different tasks of preventive maintenance should be achieved daily, weekly, monthly or annually. Preventive maintenance could be divided into two levels: periodic maintenance and predictive maintenance.

Periodic maintenance

Both personnel using the equipment daily and the person in charge of maintenance are involved in condition-monitoring tasks in a routine way.

Possible method for periodic preventive maintenance

- Documents such as follow-up forms have to be elaborated beforehand

- The person in charge of maintenance completes periodically the follow-up forms

- Any instrument should also be provided with its own maintenance book, where specific actions can be described precisely.

Predictive maintenance

The person in charge of maintenance is also involved in life-extending tasks, which have to be

Scheduled regularly, even if less frequent than routine, in order to prevent faults from occurring in the long-term. The aim in this case is to identify imminent troubles and bring Solutions to prevent equipment from failing, mainly by inspecting and then correcting,

Adjusting and/or replacing parts.

- ✓ **Suggest solutions to faced challenges**

Find the way to get solution to against future faults. In a well-managed maintenance system, all inspections done during preventive or corrective.

Maintenance should be listed, recorded and archived every year in order to provide long term monitoring. Corrective maintenance is systematically done after a mechanical or electrical failure. It aims at quickly restoring the equipment and making it reliable again. This action consists in analyzing the problem and solving it, generally by replacing pieces when possible.

- ✓ **Propose the periodic checkup**

Elaborate how you can prevent faults by doing frequently maintenance to avoid faults. Both personnel using the equipment daily and the person in charge of periodic checkup are involved in condition-monitoring tasks in a repetitive way.

Possible method for periodic checkup

- Documents such as follow-up forms have to be elaborated beforehand

- The person in charge of maintenance completes periodically the follow-up forms

- Any instrument should also be provided with its own maintenance book, where specific actions can be described precisely.

its owner within 3 hours. The documentation of the work done is highly required. Note: The manual

of dc power supply is provided.

 Summary for the trainer related to the indicative content (key notes using bullets such as ticks etc)

Element Of Technical Recommendation

a. Propose preventive strategies
b. Suggest solutions to faced challenges
c. Propose the periodic check up

Theoretical learning Activity

- ✓ **outline the elements of technical recommendation**

  answer

  - ➢ Propose preventive strategies
  - ➢ Suggest solutions to faced challenges
  - ➢ Propose the periodic check up

(example: ask trainees to brainstorm about……. within groups)

Practical learning Activity

Methodically, develop a technical recommendation according to the repaired dc power supply

(Example: Trainees in pair perform ……)

indicator	SCORE	
	YES	NO
Indicator: elements of technical recommendation are well described		
✓ Propose preventive strategies		
✓ Suggest solutions to faced challenges		
✓ Propose the periodic check up		
observation		

Points to Remember (Take home message)

Possible method for periodic preventive maintenance

- Documents such as follow-up forms have to be elaborated beforehand

- The person in charge of maintenance completes periodically the follow-up forms

- Any instrument should also be provided with its own maintenance book, where specific actions can be described precisely.

REFERENCE

Witkin, B. &. ((1995).). *Planning and Conducting Needs Assessment.* Sage Publications, Inc.

Formative assessment (Written assessment)

Q1: list down five (5) tools used to repair dc power supply

Answer:

Answer:

- ✓ Soldering irons
- ✓ Screwdrivers
- ✓ Pliers
- ✓ Cable cutters
- ✓ Crimping tools
- ✓ Knife
- ✓ Brushes
- ✓ Sponge

Soft cloth

Q 2: Give the difference between material and equipment used in dc power supply**.**

Answer:

material: is physical substance that made any thing

Equipment: is a set of tools and material designed to perform one particular task

Q3: Complete with Decreases or increases

If the load resistance decreases in a Zener regulator, then zener current…**increases**

Q4: complete the empty space with 1) **I**ncrease**, 2)** Decrease**, 3)** Stay the same**, 4)** No answer

a) If the load current is drawn by unregulated power supply increases, the dc output voltage will Decrease

Q5: Answer by **True** or **False(2marks)**

Stability of output voltage is entirely depend on zener or regulator IC …**True.**

Q6: choose the best answer

a) The nonstandard value of zener diodes voltage is .. **5.8V**

b) 6.2V
c) 5.8V
d) 5.1V
e) 5.6V

Q7: What is the application of filter in dc power supply?

Answer: **Filter:** is used to Reduce the ripples factor in un regulated dc power supply

Q8: Outline four (4) source of dc power supplies?

Answer:

- ✓ **Dry cell**
- ✓ **Battery**
- ✓ **Rectifier**
- ✓ **Solar energy**

Q9: Describe the types of IC voltage regulator

Q10:A) Identify the difference between current and voltage in DC power supply?

Answer:

Voltage: is the force needed to push/ move electrons from one points to another through the conducting material.

Current: is the movement of electrons in the conducting material

B) what is the function of Step down transformer?

Answer:

Step down transformer: Is the types of transformer used to decrease the voltage from high level to lower desired level

C) As a trainee who studied level five in field of electronic services, why all devices need power supply?

Answer: Because all electronic devices work on base of dc power current

Q11: Distinguish the functions of variable resistor in variable DC power supply.

Answer:

Variable resistor: Is used to regulate the desired level of output voltage and current

Q12:a. Explain clearly at least five (5)common faults of dc power supply with their corresponding troubleshooting techniques?

Answer:

A. no input: check the power cable or fuse or switch

B. over heat: cooling system

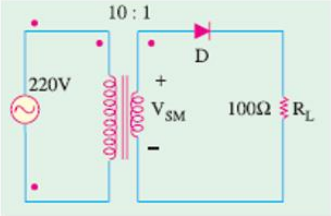
C. open circuit of secondary winding: to rewinding the second winding of transformer

D. blown up of rectifier: replacement diode

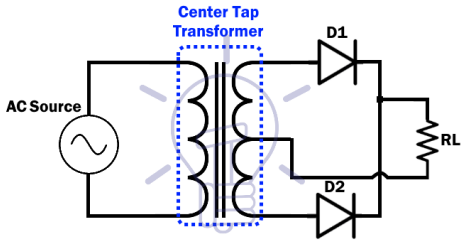
E. without full dc on output: blown up smoothing capacitor or IC regulator

a. By neat Sketch draw different type of diode rectifier

b) half wave rectifier(one diode)

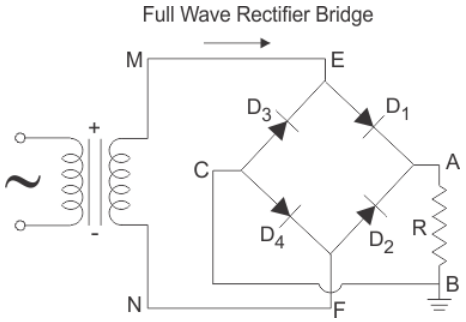


c) full wave rectifier(two diodes)

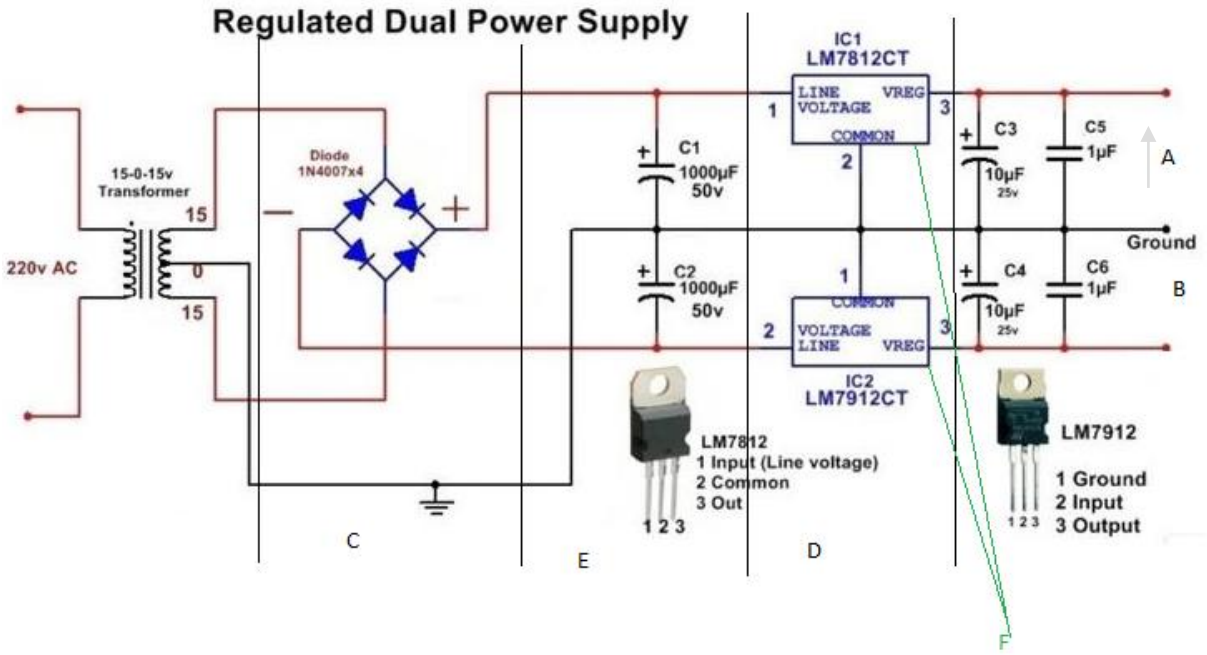


Center Tap Rectifier

d) full wave bridge rectifier (four diodes)



Question 13:analyze the circuit below and answer the questions follows:



a) Give the output of letter marked A&B

b) Name the components of the part C

Answer:

c) Give the output of letter marked A&B**(2marks)**

A- Is +12VDC output

B- Is -12VDC output

1mark for each

d) Name the components of letters C**(1mark)**

Rectifier for converting AC into DC

e) Give the function of parts labeled D& E**(2marks)**

D-Regulators used to regulate the output voltage to the desired 12vdc

E- Is smoothing capacitor that used to remove the ripple factor in dc output 1mark for each

f) Give the importance of components F**(1mark)**

F- Is used to regulate the output into desired value lm 7812ct used to regulate +12vdc and lm7912ct used to regulate -12vdc 1mark

Integrated situation

United Electronic Technician Ltd Company located in musanze city,muhoza sector, mugera cell has assigned different tasks to its technicians. You, as electronic lab technician, are requested to repair a DC Power supply (Tek-power TP1830SBDC Adjustable DC power supply1.5-15V, 30A with Digital Display) at MEGA Industry. When you switch ON; the Power supply does not deliver the output voltage. The DC power supply must be submitted toits owner within 3 hours. of the work done is highly required. Note: The manual of dc power supply is provided.

Criteria	**checklist**	**score**	
		yes	**no**
✓ **Quality of process**	✓ **Indicator: tools, equipment and materials are well selected**		
	✓ **Tools**		
	✓ Brush		
	✓ Screwdriver		
	✓ Soldering iron		
	✓ pliers		
	✓ Allen keys		
	✓ Disoldering pump		
	✓ **Materials**		
	✓ Screws		
	✓ Soldering wire		
	✓ Electronic components		
	✓ Wires		
	✓ glue		
	Equipment		
	✓ DC power supply		
	✓ Multimeter		
	✓ PPE		

	✓ Soldering gun		
	✓ Screwdriver machine		
	Indicator: disassembling process is well performed		
	✓ Cover removal		
	✓ Transformer removal		
	✓ Rectifier removal		
	✓ Filter circuit removal		
	✓ Regulator circuit removal		
	✓ Cooling system removal		
	Indicator: fault identification techniques are well applied		
	✓ Visual technique		
	✓ Measuring technique		
	Indicator: the fault fixing techniques are well applied		
	✓ Replacement of defected component		
	✓ Open circuit removal		
	✓ Short circuit removal		
	Indicator: DC power supply testing techniques are well applied		
	✓ Continuity testing		
	✓ Voltage measurement		
	✓ Current measurement		
	✓ Electronic component test		
	✓ Functionality of dc power supply		
	Indicator: documentation of the work is well done		
	✓ Handover of the repaired equipment		
	✓ Submission of the elaborated report		
	✓ Provision of the invoice		
Quality of product	**Indicator: the DC power supply is well repaired**		

	✓ Dc output voltage is delivered		
	✓ The adjustable buttons are in good condition		
	✓ No new fault is introduced		
	Indicator: the DC power supply parts are properly fixed		
	✓ Steadiness of fan		
	✓ Steadiness of rectifier		
	✓ Steadiness of filter		
	✓ Steadiness of cover		
	✓ Steadiness of transformer		
	✓ Steadiness of screws		
Relevance	**Indicator: detected fault is well rectified**		
	✓ The dc power supply output voltage is verified		
	✓ The dc power supply is working properly		
	Indicator: the documentation of work is well done		
	✓ Repair date		
	✓ Addresses of technician		
	✓ Status of DC power supply parts		
	✓ Name of the repaired parts		
	✓ Work carried out		
	✓ recommendation		
	Indicator: Working conditions are well respected		
	✓ Time is respected		
	✓ No waste of materials		
Safety	**Indicator: safety rules and guidelines are well respected**		
	✓ Individual safety precaution		
	✓ Electrical safety precaution		
	✓ Operating safety precaution		

Observation

References:

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