TVET CERTIFICATE III in ELECTRONIC SERVICES



Credits: 4

Sector: Technical services Sub-sector: Electronic services

Module Note Issue date: October, 2020

Purpose statement

Learning hours: 40

This core module describes the skills, knowledge and attitude required to repair audio amplifier. The learner will be able to select and arrange different materials, equipment and tools used when repairing audio amplifier. Moreover, he/she will be able to repair different parts of an audio amplifier including; audio amplifier power supply and amplifying circuits.

Elements of competence and performance criteria		
Learning Unit	Performance Criteria	Page No.
1. Prepare for audio amplifier repair	1.1 Proper preparation of the working place according to the work to be done	3
	1.2 Proper identification of the main parts of audio	
	1.3 Appropriate disassembling /assembling of	
	audio amplifier according to disassembling /	
	assembling techniques	
2. Repair audio amplifier motherboard	2.1 Proper description of audio amplifier mother	30
	board according to the standards	
	2.2 Proper identification of common faults in audio	
	amplifier motherboard according to their types	
	2.3 Correct rectification of common faults in audio	
	amplifier motherboard according to their	
	rectification techniques	
	2.4 Correct testing of audio amplifier motherboard	
	according to diagnostic techniques.	
3. <u>Clean the workplace</u>	3.1 Proper identification of cleaning tools and	53
	materials according to their types	
	3.2 Convenient arrangement of tools and materials	
	according to their types	
	3.3 Methodical management of waste materials	
	according to their types	
4. Elaborate the report and invoice	4.1 Proper identification of elements of the report	73
	according to their types	
	4.2 Proper identification of tools, materials and	
	equipment according to their types	
	4.3 Suitable development of repair report	
	according to the repaired equipment	
	4.4 Suitable development of invoice according to	
	the work done	

Total number of pages: 91



Learning unit 1: Prepare for audio amplifier repair

L.O 1.1: Prepare the working place

• Topic 1: Types of tools, materials and equipment used for audio amplifier repair and their use

1. Universal screw drivers

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. The tip may be hardened to resist wear, treated with a dark tip coating for improved visual contrast between tip and screw or ridged or treated for additional 'grip'. Handles are typically wood, metal, or plastic and usually hexagonal, square, or oval in cross-section to improve grip and prevent the tool from rolling when set down. Some manual screwdrivers have interchangeable tips that fit into a socket on the end of the shaft and are held in mechanically or magnetically. These often have a hollow handle that contains various types and sizes of tips, and a reversible ratchet action that allows multiple full turns without repositioning the tip or the user's hand.



2. Flat screw drivers

A flat head screw driver is a screw driver with a wedge-shaped flat tip, used to tighten or loosen screws that have a straight, linear notch in their heads.



3. Allen keys

A hex key, Allen wrench or Allen key, is a simple tool used to drive bolts and screws with hexagonal sockets in their heads. The tool is usually formed of a single piece of hexagonal rod of hard steel, with blunt ends that are meant to fit snugly into the screw's socket, bent in an "L" shape with unequal arms. Each key is meant to be used with screws of a specific socket size, with rather tight tolerances; so the tool is commonly sold in kits that include half a dozen or more keys of different sizes.



4. 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.



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 Phillip head driver bit which is the correct size to suit most types of these screws. Other common driver bits you



hich fits over roofing screws.

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're using Phillips head bits screws which don't lock into the head of a screw as well as other types of bits. Once you get used to using your drill as a screwdriver, you can try cranking up the speed to get through the job quicker.



Select the right action setting



The action setting is the switch on the drill with pictures of a screw, a hammer and a drill bit. Turn it to the screw setting which means the drill is ready to drive screws. The other settings are for general drilling and for putting the drill into hammer mode when you're drilling into bricks or concrete.



What is the torque setting?

The torque setting is the adjustable collar on the drill with a whole lot of numbers on it. Torque is the turning power of the drill and the torque setting allows you to control how much force is applied to turn the screw. Putting the drill at the correct torque setting will mean you don't overdrive the screw. Test it out at the start of the job to get the right setting to suit the job you're doing. Generally soft materials need a low torque setting while for harder materials crank it up to a higher number.





5. Universal 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. This arrangement creates a mechanical advantage, allowing the force of the hand's grip to be amplified and focused on an object with precision. The jaws can also be used to manipulate objects too small or unwieldy to be manipulated with the fingers.

Pincers are a similar tool with a different type of head used for cutting and pulling, rather than squeezing. Tools designed for safely handling hot objects are usually called tongs. Special tools for making crimp connections in electrical and electronic applications are often called "crimping pliers" each type of connection uses its own dedicated tool.



6. Cutting plier

Diagonal plier is also called side cutters, are a similarly-shaped tool for cutting rather than holding, using a pair of stout blades, similar to scissors except that the cutting surfaces meet parallel to each other rather than overlapping.



Page **7** of **91**

7. Stripping pliers

With ergonomic handles and a specially designed grip, surface union plier provides maximum comfort at work and high efficient with minimum strain, this plier is made of excellent steel with special improved composition. Several models come with additional chrome surface protection. This plier also has high precision hold in any instance of general or dedicated use.

8. Air blower 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.



Features of air blowers

The electric air blower is easy to use the device with features such as

- ✓ May air blowers come with blowing and extraction features
- ✓ For different function, this hand-held machine has a variable speed control option
- ✓ Air blowers have a strong and comfortable grip for long hour usage with minimal fatigue.
- ✓ These are made from the strong material but lightweight
- ✓ They come in the cordless form as well
- Air blowers don't create much noise, thus can be used without disturbing neighbors and environment



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.

✓ <u>Forward-curved</u>

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

✓ <u>Backward-curved</u>

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.

✓ <u>Airfoil</u>

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

✓ <u>Radial</u>

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	With centrifugal force, a large volume of air	
pressure	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 longtime use.

9. Soldering irons

A **soldering iron** 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. A soldering iron is composed of a heated metal tip and an insulated handle. Heating is often achieved electrically, by passing an electric current (supplied through an electrical cord or battery cables) through a resistive heating element. Cordless irons can be heated by combustion of gas stored in a small tank, often using a catalytic heater rather than a flame. Simple irons less commonly used today than in the past were simply a large copper bit on a handle, heated in a flame. Soldering irons are most often used for installation, repairs, and limited production work in electronics assembly.



10. Di-soldering pump

Electrically operated pumps are used for several purposes in conjunction with a hand-held head connected by a tube. Suction pumps are used to suck away molten solder, leaving previously joined terminals disconnected. They are primarily used to release through-hole connections from a PCB. The desoldering head must be designed so that the extracted solder does not solidify so as to obstruct it, or enter the pump, and can be removed and discarded easily. It is not possible to remove a multi-pin part by melting solder on the pins sequentially, as one joint will solidify as the next is melted; pumps and solder wick are among methods to remove solder from all joints, leaving the part free to be removed.



11. 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 V Ω 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.



12. Cleaning brush

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.



13. 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. Sometimes simple soldering stations are used for household applications and for hobbies.

The main soldering station elements which determine its compatibilities are soldering tools. Different tools are used for different applications and soldering stations may be equipped with more than one of them at a time.



The main tools for soldering are:

- 1. Contact soldering irons;
- 2. Disoldering tweezers or smd hot tweezers;
- 3. Desoldering gun;
- 4. Hot air gun;
- 5. Infrared heater.



Soldering iron is the most common working tool of a soldering station. Some stations may use simultaneously several soldering irons to make the process quicker and more convenient, as there is no need to change the soldering tips or readjust the station or the soldering temperature. Some stations may use some specialized soldering irons, such as ultrasonic soldering irons or induction soldering irons.

Soldering iron as a part of soldering station has a number of advantages.

- ✓ Increased operability
- The operator may set the temperature according to the solder alloy in use
- Stability of the preset temperature.
- Operation mode indication, including temperature display.



- ✓ Better heating element quality
- ✓ Main unit with power supply
- Galvanic isolation of the heating element from the electricity network. This increases your own safety and protects the components you are soldering.
- Heating element operates under low voltage (10-30 V). It is good for safety. It prolongs the heating element lifetime as well.
- Grounding of the whole unit.
- The station has a fuse.
 - ✓ Increased user comfort
- The working part has smaller size and weight.
- Station design integrates soldering aid accessories: soldering iron stands, soldering tip cleaners, etc.
- Some stations have auto switch-off function.

However, most soldering stations can be used on your desktop only. Also, it costs more than just a separate soldering iron.

Desoldering Tools

Desoldering is a very important stage in PCB repair. It is often needed to disassemble some components just to make sure they work or check their condition. That is why it is important to detach the elements without any possible damage to them.

The means that may be integrated in soldering stations are:

✓ Surface mount device (SMD) hot tweezers

Heat up and may not only melt the solder alloy but grab the needed component as well. They may have different types of tips for different applications.



✓ Desoldering iron

Disoldering iron is usually made in a shape of a gun. It is capable of taking in the air (vacuum pickup) and solder alloy.

✓ Non-contact heating tools

include hot air and infrared heaters. They are used for SMT disassembling.

Hot Air Guns

They use a hot air stream for heating up the components. Hot air is focused on the certain area using special hot air nozzles. Usually soldering hot air guns are capable of providing temperatures from 100 to 480 °C.

Infrared Heaters

Soldering stations with infrared (IR) heaters are a separate type of soldering stations and differ a lot. Such stations provide high-precision soldering and the process is more like that in electronics industry. The temperature profile may be set based on the components being soldered. This minimizes the risk of components deformation or damage due to the temperature difference.

15. Magnify glass

A **magnifying glass** (called a **hand lens** in laboratory contexts) is a convex lens that is used to produce a magnified image of an object. The lens is usually mounted in a frame with a handle. A magnifying glass can be used to focus light, such as to concentrate the sun's radiation to create a hot spot at the focus for fire starting.





16. Hacksaw

A hacksaw is a fine-toothed saw, originally and mainly made for cutting metal. The equivalent saw for cutting wood is usually called bow saw. Most hacksaw are hand saws with a C- shaped walking frame that hold a blade under tension.



17. Gun glue stick

hot melt adhesive (HMA), also known as hot glue, is a form of thermoplastic adhesive that is commonly sold as solid cylindrical sricks of various diameters designed to be applied using a hot glue gun. The gun uses a continous duty heating element to melt the plastic glue, which the user pushes through the gun either with a mechanical trigger mechanism on the gun squeezed out of the heated nozzle is initially hot enough to burn and even blister skin.



18. 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). In appropriate situations disposable PPE may be provided; e.g. single-use coveralls. Employers have duties concerning the provision and use of personal protective equipment at work.





• Topic 2: Arrangement of tools, materials and equipment in the working place.

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







L.O 1.2: Identify the main parts of an audio amplifier

• Topic 1: Introduction on audio amplifier operation (main blocs and their functions)

An audio power amplifier (or power amp) is an electronic amplifier that amplifies low-power electronic audio signals such as the signal from radio receiver or electric guitar pickup to a level that is high enough for driving loudspeakers or headphones.



Audio amplifier block diagram

1. Audio generators and auxiliary input

A signal generator is one of electronic devices that generates electronic signals with set properties of amplitude, frequency, and wave shape. Signal generators may be free-standing self-contained instruments, or may be incorporated into more complex automatic test systems. Such as *FM board, MP3 board and flash memories detectors.*



2. Power amplifier main board and controls

Amplifier and power amplifier amplifies the small audio signal (voltage) from the audio generators and external input like flash disk. Controls adjust the nature of the audio signal. Adjusts the balance of high and low frequencies. The volume control adjusts the strength of the signal. Then Power Amplifier increases the strength (power) of that audio signal.

3. Regulated Power Supply System

Provide DC electrical power source to the main electronic board located inside the audio amplifier and all electrical power source needed are supose to be provided by the power supply system such as 12DC Voltage and 5DC Voltage.

4. Loudspeaker

A transducer which converts the audio signal to sound.

• Topic 2: External parts of audio amplifier

1. Cover: this is the external part of audio amplifier used to protect the internal boards



2. Input selector: this external part of audio amplifier are used to select the input signal allow to pass in amplifier board such as FM, USB and AUX signal

Page **19** of **91**



3. Equalizer: this external part of audio amplifier is used to control the treble and base signal feed to the loudspeaker.



4. Power inlet: this external part of audio amplifier is used to supply electrical current to the internal boards of audio amplifier.



Audio/video inlet and outlet systems (USB driver, HDMI driver, SD CARD driver): these are the different input audio signal sources feed to the amplifier board.



5. Power, signal and protection indicator: these are the Leds indicators or LCD display indicate the presence of power and kind of input signal used by audio amplifier board.





6. Treble, Bass and Master volume control: these are the knob control used in adjustment of base or treble and volume increments



7. Power switch, MIC volume control and MIC socket: the power switch are used to switch the electrical current in audio amplifier and the mic volume and socket are used in adjustment of auxiliary signal comes from microphone.



8. Sound source input signals and Outlet terminals: the input signal can be different by using input selector and the outlet terminal is where you connect your loudspeaker.





9. Displayers: are used as indicator to show the content of current signal used. Such as types of input signal and its channel or duration



• Topic 3: Internal parts of audio amplifier

1. Regulated Power Supply System

- *Transformer* steps down 230V AC mains to low voltage AC.
- Chopper transformer is a device that convert fixed DC input to a variable DC output directly. Also is an electronic switch that is used to interrupt one signal under the control of another.
- **Rectifier** converts AC to DC, but the DC output is varying.
- **Smoothing filter smooth's**, the DC from varying greatly to a small ripple.
- **Regulator** eliminates ripple by setting DC output to a fixed voltage.





2. Amplifier

i. Audio generators and auxiliary input

A signal generator is one of electronic devices that generates electronic signals with set properties of amplitude, frequency, and wave shape. These generated signals are used as a stimulus for electronic measurements, typically used in designing, testing, troubleshooting, and repairing electronic or electroacoustic devices, though it often has artistic uses as well. A signal generator may be as simple as an oscillator with calibrated frequency and amplitude. More general-purpose signal generators allow control of all the characteristics of a signal. Modern general-purpose signal generators will have a microprocessor control and may also permit control from a personal computer. Signal generators may be free-standing self-contained instruments, or may be incorporated into more complex automatic test systems. Such as *FM board, MP3 board and flash memories detectors.*



ii. Audio Amplifier System and controls

Amplifier and power amplifier amplifies the small audio signal (voltage) from the audio generators and external input like flash disk. Controls adjust the nature of the audio signal. Adjusts the balance of high and low frequencies. The volume control adjusts the strength of the signal. Then Power Amplifier increases the strength (power) of that audio signal.





iii. Loudspeaker

A transducer which converts the audio signal to sound.



iv. Cooling system

Cooling system must be connected to the power supply wires of an amplifier through electrical wires. Whenever you will turn ON the amplifier. Cooling system(fan) will also start cooling the amplifier. Therefore, the chances of overheating would be quite low. The audio amplifier cooling system include: i) **fan** used to draw cooler air into the case from the outside, expel warm air from inside and move air across a heat sink to cool a particular component. Ii) **heatsink** is the passive heat exchanger that transfers the heat generated by electronic or mechanical devices to a fluid medium often air or a liquid coolant, where it is dissipated away from the device, thereby allowing regulation of the device's temperature. Iii) **thermal compound** is a thermally conductive used as an interface between heat sinks and heat sources such as high power semi-conductor



devices. The main role of thermal paste is to eliminate air gaps or spaces from the interface area in order to minimize heat transfer and dissipation.



L.O 1.3: Assemble/disassemble an audio amplifier

Disassembling an audio amplifier

This is process of breaking down a device into separate parts. Make sure the audio amplifier is turned off, then start. The standard way of removing cases used to be to undo the screws on the case. The screwdrivers as per the type of screw are required to do that task after detaching the internal board from the audio amplifier. It includes removing the power cable from electricity switchboard, before removing all the connectors from the motherboard, make sure you memorize the connectors for assembling the audio amplifier if required, as that may require connecting the connectors at its place. Remove the screws from the back of the motherboards and you will be able to detach it from the cabinet.

Assembling an audio amplifier

The assembling of the audio amplifier is exactly the opposite of disassembling operation. Before starting assembling the audio amplifier, make sure you have the screws and a screwdriver for those screws header. The first step for assembling the audio amplifier starts with mounting the motherboards in socket of the case. you don't need to apply any force. The special ZIF (zero insertion force) to prevent any damage to the boards inserted in the case. Now select the appropriate cable and connect one end of the cable to its socket and another end at its



appropriate connector on the motherboards for linking them together. Put on the cover and start screwing the screws in its appropriate holes by using correspond screwdrivers.

• Topic 1: Introduction on audio amplifier operation (main blocs and their functions)

An audio power amplifier (or power amp) is an electronic amplifier that amplifies low-power electronic audio signals such as the signal from radio receiver or electric guitar pickup to a level that is high enough for driving loudspeakers or headphones.



Audio amplifier block diagram

a. Audio generators and auxiliary input

A signal generator is one of electronic devices that generates electronic signals with set properties of amplitude, frequency, and wave shape. Signal generators may be free-standing self-contained instruments, or may be incorporated into more complex automatic test systems. Such as *FM board, MP3 board and flash memories detectors.*

b. Power amplifier main board and controls

Amplifier and power amplifier amplifies the small audio signal (voltage) from the audio generators and external input like flash disk. Controls adjust the nature of the audio signal. Adjusts the balance of high and low frequencies. The volume control adjusts the strength of the signal. Then Power Amplifier increases the strength (power) of that audio signal.



c. Regulated Power Supply System

Provide DC electrical power source to the main electronic board located inside the audio amplifier and all electrical power source needed are supose to be provided by the power supply system such as 12DC Voltage and 5DC Voltage.

d. Loudspeaker

A transducer which converts the audio signal to sound.

• Topic 2: External parts of audio amplifier

- i. Cover: this is the external part of audio amplifier used to protect the internal boards
- **ii. Input selector:** this external part of audio amplifier are used to select the input signal allow to pass in amplifier board such as FM, USB and AUX signal
- **iii.** Equalizer: this external part of audio amplifier is used to control the treble and base signal feed to the loudspeaker.
- **iv. Power inlet**: this external part of audio amplifier is used to supply electrical current to the internal boards of audio amplifier.
- v. Audio/video inlet and outlet systems (USB driver, HDMI driver, SD CARD driver): these are the different input audio signal sources feed to the amplifier board.
- **vi. Power, signal and protection indicator:** these are the Leds indicators or LCD display indicate the presence of power and kind of input signal used by audio amplifier board.
- vii. Treble, Bass and Master volume control: these are the knob control used in adjustment of base or treble and volume increments
- viii. Power switch, MIC volume control and MIC socket: the power switch are used to switch the electrical current in audio amplifier and the mic volume and socket are used in adjustment of auxiliary signal comes from microphone.
- **ix.** Sound source input signals and Outlet terminals: the input signal can be different by using input selector and the outlet terminal is where you connect your loudspeaker.
- **x. Displayers**: are used as indicator to show the content of current signal used. Such as types of input signal and its channel or duration



Topic 3: Internal parts of audio amplifier

1. Regulated Power Supply System

- *Transformer* steps down 230V AC mains to low voltage AC.
- Chopper transformer is a device that convert fixed DC input to a variable DC output directly. Also is an electronic switch that is used to interrupt one signal under the control of another.
- **Rectifier** converts AC to DC, but the DC output is varying.
- **Smoothing filter smooths**, the DC from varying greatly to a small ripple.
- **Regulator** eliminates ripple by setting DC output to a fixed voltage.

2. Amplifier

i. Audio generators and auxiliary input

A signal generator is one of electronic devices that generates electronic signals with set properties of amplitude, frequency, and wave shape. These generated signals are used as a stimulus for electronic measurements, typically used in designing, testing, troubleshooting, and repairing electronic or electroacoustic devices, though it often has artistic uses as well. A signal generator may be as simple as an oscillator with calibrated frequency and amplitude. More general-purpose signal generators allow control of all the characteristics of a signal. Modern general-purpose signal generators will have a microprocessor control and may also permit control from a personal computer. Signal generators may be free-standing self-contained instruments, or may be incorporated into more complex automatic test systems. Such as *FM board, MP3 board and flash memories detectors*.

ii. Audio Amplifier System and controls

Amplifier and power amplifier amplifies the small audio signal (voltage) from the audio generators and external input like flash disk. Controls adjust the nature of the audio signal. adjusts the balance of high and low frequencies. The volume control adjusts the strength of the signal. Then Power Amplifier increases the strength (power) of that audio signal.



iii. Loudspeaker is a transducer which converts the audio signal to sound.

3. Cooling system

Cooling system must be connected to the power supply wires of an amplifier through electrical wires. Whenever you will turn ON the amplifier. Cooling system (fan) will also start cooling the amplifier. Therefore, the chances of overheating would be quite low. The audio amplifier cooling system include: i) **fan** used to draw cooler air into the case from the outside, expel warm air from inside and move air across a heat sink to cool a particular component. Ii) **heatsink** is the passive heat exchanger that transfers the heat generated by electronic or mechanical devices to a fluid medium often air or a liquid coolant, where it is dissipated away from the device, thereby allowing regulation of the device's temperature. Iii) **thermal compound** is a thermally conductive used as an interface between heat sinks and heat sources such as high power semi-conductor devices. The main role of thermal paste is to eliminate air gaps or spaces from the interface area in order to minimize heat transfer and dissipation.

Learning unit 2: Repair audio amplifier mother board

L.O 2.1: Describe audio amplifier mother board

• Topic 1: Main parts of audio amplifier mother board



1. Transformer

A transformer is defined as a passive electrical device that transfers electrical energy from one circuit to another through the process of electromagnetic induction. It is most commonly used to increase ('step up') or decrease ('step down') voltage levels between circuits. The working principle of a transformer is very simple. Mutual induction between two or more windings (also known as coils) allows for electrical energy to be transferred between circuits.





2. Chopper transformer

A chopper is a device that converts fixed DC input to a variable DC output voltage directly. Essentially, a chopper is an electronic switch that is used to interrupt one signal under the control of another. In power electronics applications, since the switching element is either fully on or fully off, its losses are low and the circuit can provide high efficiency. However, the current supplied to the load is discontinuous and may require smoothing or a high switching frequency to avoid undesirable effects. DC to DC converter is very much needed nowadays as many industrial applications are dependent upon DC voltage source. The performance of these applications will be improved if we use a variable DC supply. It will help to improve controllability of the equipment also. Examples of such applications are subway cars, trolley buses, battery operated vehicles etc. We can control and vary a constant DC voltage with the help of a chopper.





3. Rectifier

A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction. The reverse operation is performed by the inverter. A rectifier diode (silicon controlled rectifier) and associated mounting hardware. The heavy threaded stud attaches the device to a heatsink to dissipate heat. The process is known as rectification, since it "straightens" the direction of current.





4. Filter

The job of the capacitor in the output filter of a DC power supply is to maintain a constant DC value by removing as much power ripple as possible. Because these capacitors have a DC value, they are actually storing a lot of energy that never gets used.

All AC-DC converters, whether they are linear supplies or have some kind of switching element to them, require a mechanism to take the varying power on the AC side and produce a constant power on the DC side. Typically, a large filter capacitor is used to absorb and store energy when the AC power is higher than what is needed by the DC load and to supply energy to the load when the AC power is lower than what is needed.





5. Regulator

A voltage regulator is a system designed to automatically maintain a constant voltage level. A voltage regulator may use a simple feed-forward design or may include negative feedback. It may use an electromechanical mechanism, or electronic components. Depending on the design, it may be used to regulate one or more AC or DC voltages.



6. Amplifier

It is used to increase or amplifies the strength of weak audio signal to a desire level can be heard through our ears.





7. Cooling systems

Components are often designed to generate as little heat as possible, electronic devices may be designed to reduce power consumption and consequent heating according to workload, but more heat may still be produced than can be removed without attention to cooling. Use of heatsinks cooled by airflow reduces the temperature rise produced by a given amount of heat. Attention to patterns of airflow can prevent the development of hotspots. Amplifier fans are widely used along with heatsink fans to reduce temperature by actively exhausting hot air.



• Topic 2: General faults that occur in audio amplifier and their diagnostic techniques

A. No input voltage

When there is no indicator either LEDs or display light up when the power supply is working properly and the power switch is pressed it means there is no input voltage. You may first check the power cable and the fuse if they are not damaged.by using continuity test and voltage measurement.

B. IC amplifier blown up

When there is no output signal while the amplifier is working properly. It means that all indicators show the amplifier is working but there is no sound feed in loudspeaker, you have to check the



amplifier ICs. Which are mounted near the big heatsink. When they are damaged replace with the equivalent ICs.



C. Blown up filter

When the output signal feed to the loudspeaker are too noisily this means the filter capacitor have the problem, then remove it and replace with the equivalent capacitor (means the capacitor have the same rating as exist one).



D. Blown up resistors

When the resistor is blown there is no current flows in that path or the other parts of the board. So you have to change resistor by its equivalent resistor after testing by continuity test or voltage and current test.

E. Blown rectifier

When the input voltage is available but the power supply does not provide the voltage to other boards are located inside, firstly check if the rectification part is working properly. When the rectification diode is damaged, replace with its equivalent diode after testing with both continuity test and voltage measurement test.





F. Blown transformer

When a transformer is not working it means its coil are burned, the coil color change from red to black when it is already burned because of overvoltage or shot circuit happening either in primary side or secondary side of transformer. By using digital multimeter measure the continuity test on each side of transformer. Then read the value of coil resistance, once the reading is approximately zero. It shows that transformer side coils are burned. You can replace with another transformer have the same rating or rewinding the coils of transformers.



G. Blown chopper transformer

Chopper transformer use fixed DC voltage and provide variable DC voltage to the different board need that different voltage, so when the chopper transformer is not working properly some board does not get electrical current for better performance. By using voltage measurement test, identify the faults of chopper transformer and replace with its equivalent or rewinding the coils.




H. Cooling system faults

Cooling system consist of heatsink, thermal compound and fan. Many audio amplifier use heatsink and thermal compound in their cooling system, when the device experienced with overheat. The sign of cooling system failure. So check if the fan is working well and the components are connected to the heatsink before disassembling of device.



- L O. 2.2: Identify common faults in audio amplifier motherboard
- Topic: Main parts of audio amplifier mother board
 - ✓ Transformer faults are:
 - Overheat faults
 - Winding faults
 - Open faults
 - External faults



- Over fluxing faults
- Earth faults
- Phase faults
- Inter turn faults
- Core faults
- Cooling failure
- Tap changer faults
- ✓ Chopper transformer faults are:
 - Overheat faults
 - Winding faults
 - Open faults
 - External faults
 - Over fluxing faults
 - Earth faults
- ✓ Rectifier faults are:
 - 1. Over voltage
 - 2. Overcurrent
 - 3. Overheat
 - 4. Short circuit

Filter faults are:

Common causes of capacitor bank failure.

Inadequate voltage rating

The most common cause of catastrophic failure in capacitor banks is due to an inadequate voltage rating. This problem occurs when the voltage across the capacitor units exceeds the design values of the inductors connecting the capacitors. This is not to be confused with a blown fuse, the second most frequent cause of capacitor bank failure. When capacitor units blow their



fuses, the short circuit is a result of overvoltage, or harmonics, and most commonly occurs due to "fatigue, incorrect application and improper branch protection.

Hot in Here

Thermal failure is the third most common reason for a broken capacitor bank. Excessively hot temperatures whether from high ambient temperature, radiated heat from adjacent equipment, or extra losses is often behind these failures.

While filters are used to control these harmonics, capacitor banks may overheat and fail if they're not sharp enough. Therefore, it is crucial to install the capacitor banks in the best possible location on the network.

Our Bad

As with all sophisticated technology, there's always the possibility that we silly humans will screw it up. This can manifest itself in a number of ways, including the possibility of a manufacturer defect.

Typically, manufacturer defects can be identified when testing the capacitor units at the factory. The failure of most electrical components is represented in a "bathtub curve," where problems are most likely to occur early as "infant mortality" or during the "end of life wear-out period."

✓ Regulator faults are:

Those days you could only see the common 3 legs 78 and 79 series of voltage regulator ICs in circuit boards but now it is common to see IC voltage regulators that have more than 5 pins. Some have single output and some have multiple output voltages. The common fault for a voltage regulator IC are:

- Shorted IC
- 🖊 No output voltage
- low output voltage
- a too high output voltage and
- IC breakdown when under load



Finding the IC problems on 1 to 4 is not difficult but locating the IC that breakdown under load will be a bit difficult but unless you know what to do. Let's take a power LED blinking problem in an equipment as example. For your information most power LED signal source is coming from a microcontroller (MCU) chip. If you get a good supply voltage to the IC voltage regulator and fluctuate output, you will know that either the IC or the mainboard circuitry have problem. The problem now is that when you lifted up the output pin of the ic voltage regulators you will see that the output voltage is back to normal and this will prompt you thinking that the mainboard or the circuitry have problem. The actual fact is that the ic voltage regulator itself can't sustain the current draw from the mainboard.

✓ Amplifier faults are:

Here are four of the most common types of home audio amplifier problems.

1. Overheating

Home audio amplifiers produce a great deal of heat. As such, overheating is a very common problem with them. Overheating generally occurs when amplifiers are left on for exceedingly long periods of time or when they are placed close to other heating-generating devices. For this reason, it is important to place your amplifier in an area in which it has ample space to breathe. Overheating is also likely to occur if your amplifier's settings have been cranked up to extreme levels.

2. Humming

Humming is another common problem that has been known to occur with home audio amplifiers. Humming can be caused by a number of different factors, so it's important to know how to diagnose it. For example, if turning your volume up and down affects the loudness of the humming, the problem most likely lies with the volume control. If the level of the humming remains unchanged despite your volume settings, the source of the problem likely lies with one of the components connected to your amplifier. Humming can sometimes be remedied by making sure your components are securely connected to your amplifier. You can also use a process-of-elimination method by disconnecting each component one-by-one and listening to



see if the humming persists after each disconnection. It is recommended that you turn off your amplifier and components while the disconnection process is underway.

3. Inadequate Power Supply

Inadequate power supplies are another common source of amplifier problems. Home audio amplifiers use a good deal of power and, if run through the improper type of power supply, they may provide insufficient sound quality and not operate to their full potential. When selecting a power supply for your home audio amplifier, make sure it is capable of handling the type of voltage and electrical current given off by your amplifier.

4. Incompatible Components

Incompatible components can cause many problems with your amplifier. In addition to the previously discussed humming, incompatible components can significantly degrade your amplifier's sound quality. Before purchasing a home audio amplifier, take note of the brands and model numbers of all the components with which you wish to link the device and research which brands of amplifiers will work well with them. Online consumer testimonials are arguably the best method of conducting this research, as the internet is a fantastic source of product reviews. The research may seem cumbersome, but selecting an amplifier that works in harmony with your components will ultimately prove well worth your efforts.

✓ Cooling systems

The most common cooling system problems fall into three common areas such as overcooling, high heat and noise.

- Overheating.
- Overcooling.
- ✤ Noise.
- Topic 2: General faults that occur in audio amplifier and their diagnostic techniques

1. No input voltage

The standard supply voltages for today's systems (unipolar 3.3V or 5V, or bipolar ± 3.3 V or ± 5 V) are usually the highest voltages available on a board. The board's input terminals may be exposed to voltages higher than the supply voltages. When power to the board is off, voltages may remain

Page **41** of **91**

at the input terminals. The first element to be affected by overvoltage is often a multiplexer or a switch, so they must protect downstream circuitry.

The pass element in an analog switch contains one or more MOSFETs and has parasitic clamping diodes to the supply voltages for ESD protection. As long as V+ and V- are present and no input voltage exceeds those rails by the forward bias voltage of the clamping diodes (typically 0.6V), the diodes are reverse-biased and no current flows through them.

An input voltage with supplies off or an input voltage that exceeds a supply voltage causes current to flow through the clamping diodes. Those diodes can handle only a couple of milliwatt (depending on the IC's semiconductor process) before heat due to power dissipation damages the switch permanently. Use visual inspection or measurement techniques (digital multimeter) to identify the fault from the output to input terminals.

2. IC amplifier blown up

An amplifier is an electronic component that magnifies and controls audio signal sources from a built-in AM-FM receiver as well as an external CD player, tape player, or other audio homeentertainment device. The output signal is fed to audio speakers. Amplifiers are a great way to adjust the volume to your comfort level and meet the requirements of different occasions. However, one should realize that amplifiers are just like any other mechanical device and stop functioning due to one reason or the other.

For the amplifier to turn on in the first place, it is important that it gets the right power needed to get turned on. Check for the power wire at both the ends, one at the amplifier end and the other at the socket end. If any of these ends are not properly attached, it will pass no current. Moreover, if the voltage is too low, it will not have enough power to turn the amplifier on. If you hear no sound from the amplifiers, then you definitely have not problems either with the speakers or the cables which connect your speakers and the amplifier. For this, try to unplug the RCA cables from each unit and replace the amplifier IC. Use visual inspection or measurement techniques (digital multimeter) to identify if there is some pin of the IC are deflected by using continuity test.



3. Blown up filter

A busted capacitor can be obviously broken (leaking brownish fluid, corroded, or with the leads severed), but sometimes it's subtle. The top of a blown capacitor will be slightly bent outwards in a convex shape, rather than flat or slightly indented inwards like a working capacitor. Trim the leads of the new capacitor so that they are both even, and will sit at about the same height as the old capacitor. Position the new capacitor leads at the holes where the old capacitor was, with the correct polarity. Just like before, press the tip of the soldering iron directly onto the joint in the back of the circuit board. As soon as the tip falls into the hole, press the wire lead through the hole, then remove the iron. The old solder joint will solidify around the new part and hold it secure. Repeat with the other side. Add new solder to the joint if necessary. Use visual inspection or measurement techniques (digital multimeter) to identify if the capacitor is not bust or it can store voltage while the supply is in ON state.

4. Blown up resistors

Resistors are designed to operate under specific voltages. The voltage rating of a resistor is designated by its wattage (power) value. When a resistor is functioning under a normal voltage load, it is operating as it should under a voltage that meets or falls below its power rating. The resistor will feel cool to warm by touch. The relatively low temperature is a result of the resistor acting as a semiconductor, meaning that it is allowing only a specific amount of current to flow through. When a resistor is placed under a voltage that approaches the upper limits of its power rating, the resistor generates more heat than normal. This is due to the voltage attempting to force more current (electrons) through the resistor than it is designed to pass. The resistor will be hot to touch and a faint whiff of burning may be detectable. The burning odor is the breaking down of the components of the resistor: the carbon, the clay binding agent and the color code pigment painted on the resistor. At this point, the resistor is unable to resist the flow of current forced through by the excessive voltage and the resistor breaks down. When a resistor breaks down, current typically flows through the burnt resistor without any resistance and thereby passes unchecked. Other components in the circuit may become damaged from the excess current flowing through. Use visual inspection or measurement techniques (digital multimeter) to identify the resistor color is not black or the terminals are not broken at its ends.



5. Blown rectifier

Start by disconnecting the supply wires in your circuit board and switching the multimeter to diode function. Take a look at the positive diode by inserting the positive lead to the positive diode. Next, connect your negative lead to the stator inputs. You should not see any readings on the meter yet. Assuming everything looks good at this point, connect the positive diode to the negative lead before connecting the positive lead to all stator inputs. At this point, the meter should show you something, but the specific numbers are irrelevant. Repeat for the negative diode by connecting the positive lead to the negative diode and connecting the stator inputs and negative lead. The meter should not show any reads when you connect the positive lead and stator inputs. Connect the red probe to the anode and black probe to the cathode. This means diode is forward-biased.

Observe the reading on meter display. If the displayed voltage value is in between 0.6 to 0.7 (since it is silicon diode) then the diode is healthy and perfect. For germanium diodes this value is in between 0.25 to 0.3. Now reverse the terminals of the meter that means connect the red probe to cathode and black to anode. This is the reverse biased condition of the diode where no current flows through it. Hence the meter should read OL (which is equivalent to open circuit) if the diode is healthy. If the meter shows irrelevant values to the above two conditions, then the diode is defective. The diode defect can be either open or short. Open diode means diode behaves as an open switch in both reverse and forward-biased conditions. So, no current flows through the diode. Therefore, the meter will indicate OL in both reverse and forward-biased conditions. Replace that deflected diode by a healthy diode in the circuit.

6. Blown transformer

Performing a visual inspection of your transformer is key. Sometimes, you'll be able to see things right away that indicate a problem with the equipment itself. If you notice any knots along the exterior, for instance, or if you see any burn marks, it is a good indication that the transformer needs to be replaced. If you see visual damage, do not even try to test it! Instead, remove the old transformer and install a new one that works. Overheating or a power surge can cause substantial damage to the transformer. Those circumstances produce visual deformities and render the equipment useless. The meter reading on your transformer can also indicate whether

Page **44** of **91**

or not it is functioning properly. A bad transformer will have weak power or none at all. it may need replacement the transformer or repairs the coils deflected.

7. Blown chopper transformer

AC mains or just a rectifier when working with 230 V. Some others are designed to work from 100 to 240 V AC with no switches and the regulator does the rest. This high DC voltage is switched by one or more transistors (or MOSFETs) to drive the primary of a ferrite transformer. On the secondary side, the voltage is rectified and filtered. Switching transistors are driven by a control circuit that senses the output voltage (and input current) and regulates accordingly. This control circuit is very often on the primary side and often powered by an extra winding on the transformer. A sample of the output voltage is fed back via an opto-coupler. In some cases, the control circuit is located on the secondary side and drives the transistor(s) via a small additional transformer. All configurations have some additional circuit to allow the controller to start at power-up.

Start with a visual inspection to get an idea. Of course, first disconnect the supply and make sure all capacitor is discharged. Many faulty electrolytic capacitors, when not exploded, can easily be spotted because they "expand" and their top (or bottom) side becomes dome-shaped. Burned resistor can also be spotted by their black color and bad smell. A look to the ferrite transformer is very important: if it looks burned out and smells badly. Use visual inspection or measurement techniques (digital multimeter) include voltage and current to identify the exactly fault on chopper transformer if it should be replaced by the new equivalent one.

8. Cooling system faults

Each fan unit has a specially-constructed raised air-chamber base that enlarges the area of air flow, while also sealing air and preventing vibrations. The air-chamber base covers twice the area of a standard fan. The system has a multi-speed power transformer, which plugs into an AC outlet. You control the speed of the fan, using this transformer, which can be set to any one of 5 different speeds.



L.O 2. 3: Rectify common faults in audio amplifier mother board

• Topic 1: Audio amplifier motherboard common faults manifest and solutions

1. The amplifier fails to turn on

The first thing to do is no ensure that the audio amplifier is properly grounded. Confirm whether it is hooked to a bare metal surface. The metallic plate it is hooked onto should be rust-free and clean. In case the metallic plate looks dirty or rusty, clean it up. Scrubbing the metallic surface with a dry, stainless steel scrubber can remove the rust. Also, ensure the grounding connection is tight.

Also, ensure the power cable feeding the amp is tightly connected. Once you have confirmed that all that is okay, try powering it on. If it powers on, then you are good. If it fails to turn on, then the problem might be an interior issue with the audio amplifier motherboard. Simply open it up and check whether there is anything that looks blown, especially the power supply. Blown MOSFETS are a common issue with audio amplifier motherboard. If you notice a blown part, then you can start repairing activities by replacing that MOSFETs with it equivalent transistor.

If the audio amplifier is turning on but going into protect mode, then it might be having an issue with low impedance due to speaker wiring issues or low power when the volume is turned all the way up. If the problem is not with the speaker wiring or turning up the volume up, then the issue might be blown output transistors. To diagnose the problem, disconnect the power supply to the amp, then take a multimeter and ensure its set to ohms. Use it to measure the level of resistance that exists between the amp output transistors. A reading close to 0 should be okay but a reading of ~0 is an indicator of a problem with the transistors. Blown transistors should be replaced.

2. The amplifier is overheating and shutting down

An audio amplifier can overheat and shut down. The reason behind this problem might be low impedance, extremely high gain or bass level, poor grounding, blown speakers, or speakers connected to the audio amplifier chassis.

When the gain or bass levels are turned all the way up, then your audio amplifier may overheat and shut down. Also, if the input sensitivity is too high, the audio amplifier may overheat and shut down. Also, connecting speakers with lower impedance than the amplifier rating can lead to overheating and permanent damage audio amplifier. Ensure the gain and bass level are not turned to their maximum.

3. Making a popping, buzzing, or crackling noise

In most cases, buzzing noise from speakers is as a result of bass or gain being turned all the way up. Also, if something is touching the speaker cone, it might buzz as it vibrates. Thus, first check whether your speaker cone is away from any item such as wires and other foreign objects that may be touching it. If any object is touching the cone, keep it away from the cone and test the speaker to assess whether the buzzing noise stops. If the buzzing noise does not stop, check the gain or bass level and reduce it. If reducing the gain or bass level stops the buzzing noise, then it means your speaker can't handle that much bass or gain. A grounding loop can also make your speakers buzz. A grounding loop is usually as a result of a shared ground connection between multiple electrical devices. If this is the case, ground different devices to different metallic plates.

If your speaker is crackling and popping, then the audio amplifier might be too powerful for your speakers such that they can't handle the power they are receiving. The audio amplifier ends up sending continuous peak power to the speakers, hence they crackle and pop. Try connecting the speakers directly to the head unit. If they still crackle and pop, they are probably blown the amplifier ICs and need repair or replacement of these amplifier ICs.

4. Sound but no bass

Bass is an essential part of sound. It makes music feel deeper and you will want your audio amplifier to have the best bass. But what if you have just installed new speakers and you can't get any bass? The most common cause of this problem may be a head unit that is too weak to power the speakers hard enough for bass or there is a bad speaker cable connection. First, ensure the terminals are properly connected. If there is still no bass, then maybe you need to replace an audio amplifier IC to feed the speakers with enough power for bass.

5. Sound is cutting off

If sound from your speakers is cutting on and off, the most likely problem would be a loose speaker cable connection. Check the connection of the speaker cable from the audio amplifier connector. If it is firmly connected, then check the connection on the speaker terminals. An overheating of an audio amplifier can also make sound cut on and off. When the amplifier IC blown up, also you can check other connection can cause error in EEPROM IC, and replace that IC.

• Topic 2: Testing different parts of the audio amplifier motherboard

1. Transformer

It's rare for transformers to malfunction, but they can overheat when supplying power on a continuous basis for an extended period of time. One of the transformer connections might melt, or a break may develop in one of the wires. You can test any transformer, including a phone charger transformer, using a multimeter. In output transformer testing, you use the voltmeter setting to check the output voltage while the transformer is connected to power. In a transformer continuity test, you disconnect the transformer from power and check resistance in both the input and output coils using the ohmmeter function.

2. Chopper transformer

Set your multimeter to measure voltage and place the probes across the output of the chopper transformer. Since there is no more load, the primary side will sense an overvoltage which could shut down the power supply or totally blow up the power components such as (blowing up the power side components-power IC, power FET, resistors and etc.) You would like to test the output of the chopper transformer again by place your probe after the secondary diode output pin and check the DC voltage.

3. Rectifier

A diode is best tested by measuring the voltage drop across the diode when it is forward-biased. A forward-biased diode acts as a closed switch, permitting current to flow. A multimeters Diode Test mode produces a small voltage between test leads. The multimeter then displays the voltage drop when the test leads are connected across a diode when forward-biased. The Diode Test procedure is conducted as follows.

a) All power to the circuit is OFF



b) No voltage exists at the diode.

Voltage may be present in the circuit due to charged capacitors. If so, the capacitors need to be discharged. Set the multimeter to measure ac or dc voltage as required. Turn the dial (rotary switch) to Diode Test mode. It may share a space on the dial with another function. Connect the test leads to the diode. Record the measurement displayed. Reverse the test leads. Record the measurement displayed.

A good forward-based diode displays a voltage drop ranging from 0.5 to 0.8 volts for the most commonly used silicon diodes. Some germanium diodes have a voltage drop ranging from 0.2 to 0.3 V.

The multimeter displays OL when a good diode is reverse-biased. The OL reading indicates the diode is functioning as an open switch. A bad (opened) diode does not allow current to flow in either direction. A multimeter will display OL in both directions when the diode is opened. A shorted diode has the same voltage drop reading (approximately 0.4 V) in both directions. A multimeter set to the Resistance mode (Ω) can be used as an additional diode test or, as mentioned previously, if a multimeter does not include the Diode Test mode.

4. Filter

A multimeter determines capacitance by charging a capacitor with a known current, measuring the resulting voltage, then calculating the capacitance. a good capacitor stores an electrical charge and may remain energized after power is removed. Before touching it or taking a measurement

a) Turn all power OFF

b) Use your multimeter to confirm that power is OFF

c) Carefully discharge the capacitor by connecting a resistor across the leads and be sure to wear appropriate personal protective equipment.

Use your digital multimeter (DMM) to ensure all power to the circuit is OFF. If the capacitor is used in an AC circuit, set the multimeter to measure ac voltage. If is used in a dc circuit, set the DMM to measure dc voltage. Visually inspect the capacitor. If leaks, cracks, bulges or other signs of deterioration are evident, replace the capacitor. Turn the dial to the Capacitance

Page **49** of **91**

Measurement mode. The symbol often shares a spot on the dial with another function. In addition to the dial adjustment, a function button usually needs to be pressed to activate a measurement. The capacitor will need to be removed from the circuit. Discharge the capacitor as described in the warning above.

5. Regulator

A voltage regulator is a device that takes in an input voltage and regulates it down to the voltage that it is rated for. Being that a voltage regulator passes out a regulated output voltage, the only test we must do to check a voltage regulator is a voltage test. We check the voltage input into the voltage regulator and the voltage output from the regulator. If we read at the input pin the voltage which we feed into the regulator and read at the output pin the output voltage which the regulator is rated for, then we know that the voltage regulator is good. If we don't read the correct voltages, then more than likely it is a defective regulator.

To test the voltage going into the voltage regulator, we take a multimeter and place it in the DC voltage setting. The DC voltage setting is the setting of the multimeter that has the following symbol or sign, DC Voltage Symbol of a Multimeter. We take the probes of the multimeter and place the positive probe (normally the red probe) on the input pin of the voltage regulator and the negative probe (normally black probe) on the ground pin. The voltage that we should read should be higher than the voltage the regulator is rated to output.

If the multimeter does read a voltage near its rated output voltage, the voltage regulator is functional and is good. If we do not, then the voltage regulator is defective, as it does not do the job it was designed for, which is output a regulated voltage.

6. Amplifier

Measurements associated with power amplifiers such as Noise, Frequency response, Intermodulation distortion, etc. the amplifiers are becoming more popular and can offer significant power efficiency and size advantages. However, they present certain challenges for test. The basic operation of an amplifier involves high-frequency switching between power supply rails, which causes strong signal components outside the audio-band. This signal can interfere with the audio signal unless steps are taken to remove the high-frequency component

Page **50** of **91**

from the signal before applying it to the dScope's inputs. Prism Sound's passive low-pass filter allows these high frequency signals to be removed, preventing measurement errors (nonlinearities) due to the high slew rates and allowing the dScope to accurately measure the signal in the audio-band.

7. Cooling systems

The main function of a fan is to prevent the electronic components from overheating. It distributes cooler air through the radiator and exchanges the inside heat. This fan, having many blades, rotates quickly to send cooler air to the electronic components. It works as a part of the overall cooling system. If the fan shows any problem or stops working, you can use a multimeter to check if it has the correct voltage and its motors are working.

• Topic 2: Soldering and di-soldering different components of the audio amplifier circuit

1. Solder

Turning to the actual techniques of soldering, firstly it's 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. The frame saves an awful lot of turning the board over and over, especially with large boards. Other parts could be held firm in a modeler's small vice, for example. Solder joints may need to possess some degree of mechanical strength in some cases, especially with wires soldered to, say, potentiometer or switch tags, and this means that the wire should be looped through the tag and secured before solder is applied. The down side is that it is more difficult to de-solder the joint and remove the wire afterwards, if required. Otherwise, in the case of an ordinary circuit board, components' wires are bent to fit through the board, inserted flush against the board's surface, splayed outwards a little so that the part grips the board, and then soldered.



2. 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 at a later date! 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.

A joint which is poorly formed is often called a "dry joint". Usually it results from dirt or grease preventing the solder from melting onto the parts properly, and is often noticeable because of the tendency of the solder not to "spread" but to form beads or globules instead, perhaps partially. Alternatively, if it seems to take an inordinately long time for the solder to spread, this is another sign of possible dirt and that the joint may potentially be a dry one.

• Topic 3: Replacement of the defected components by their corresponding 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.



Learning unit 3: Clean the workplace

L O 3.1: Identify the cleaning tools and materials according to their types

• Topic 1: Tools, materials and equipment used to clean the workplace

1. Vacuum cleaner

A vacuum cleaner, also known simply as a vacuum or a hoover, is a device that causes suction in order to remove debris from floors, upholstery, draperies and other surfaces. It is generally electrically driven. The debris is collected by either a dust bag or a cyclone for later disposal.



2. Lags or cotton waste

Lags or cotton waste prevents unwanted wastage and can be a more sustainable alternative to disposal. Because waste cotton is often already dyed, re-dyeing may not be necessary. Cotton is an extremely resource-intense crop in terms of water, pesticides and insecticides. This means that using recycled cotton can lead to significant savings of natural resources and reduce pollution from agriculture.



3. Cleaning solutions

Cleaning solutions are substances (usually liquids, powders, sprays, or granules) used to remove dirt, including dust, stains, bad smells, and clutter on surfaces. Purposes of cleaning solution include health, beauty, removing offensive odor, and avoiding the spread of dirt and contaminants to oneself and others. Some cleaning agents can kill bacteria (e.g. door handle



bacteria, as well as bacteria on worktops and other metallic surfaces) and clean at the same time. Others, called degreasers, contain organic solvents to help dissolve oils and fats



4. Brush

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.



Topic 2: Collection and arrangement of tools and equipment

Collection is the accumulation of tools and equipment in their correct location, especially for storage or as a result of some process after work.

Arrangement of tools and equipment is to move and organize tools and equipment into a particular order or position to avoid the disorder in the working place. Management as well as the practices in repairing audio amplifier to avoid indisposed of tools and equipment in the workplace. Arranging tools and equipment "involves adding each tool or equipment to the existing tools and equipment for better future use and well maintained. 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 collet, and a tool holder with a machine taper. Putting the parts together accurately into an assembly is required. Logistics deals with demand planning, supplies and tool location. This includes, on one hand, the location in the warehouse and the purchasing of individual parts with the corresponding consumption report. It also allows for the planning and coordination of the movements of tools and equipment within workplace.



• Topic 3: Arrangement of non-used materials (consumables)

Logistics deals with demand planning, supplies and consumable location. This includes, on one hand, the location in the warehouse and the purchasing of individual consumable with the corresponding consumption report. It also allows for the planning and coordination of the movements of non-used materials (consumable) within workplace. For future use and well-kept in the workplace.



Page **55** of **91**

Topic 4: Cleaning of working area

1. Cleaning techniques

a. 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. Use effective guarding methods that prevent a chip or particle (of any size) from being blown into the eyes or unbroken skin of the operator or other workers nearby. You may also use barriers, baffles, or screens to protect other workers near the operator if there is a risk of exposure. In addition, air guns should also be used with some local exhaust ventilation or facilities to control the generation of airborne particulates. When compressed air cleaning is unavoidable, hazards can be reduced by making adjustments to the air gun such as:

- Chip guards or curtains that can deflect flying dust or debris,
- Extension tubes that provide the worker a safer working distance, or
- Air guns equipped with injection exhausts and particle collection bags.

b. Rushing

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.





c. Toweling

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



2. Tools used in cleaning

I. Brush

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.



II. Sponge

The definition of a sponge is 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 or what a doctor uses in surgery to clean a wound.





III. Soft clothing

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.



- Topic 5: Waste materials management
 - A. Types of waste materials
 - 1. Recyclable

Recycling is the process of converting waste materials into new materials and objects. The recyclability of a material depends on its ability to reacquire the properties it had in its virgin or original state. It is an alternative to "conventional" waste disposal that can save material and help lower greenhouse gas emissions. Recycling can prevent the waste of potentially useful materials and reduce the consumption of fresh raw materials, thereby reducing: energy usage, air pollution and water pollution. Recyclable materials include many kinds of glass, paper, cardboard, metal, plastic, tires, textiles, batteries, and electronics.

2. Bio-degradable

Biodegradable are that can be decomposed by the action of living organisms, usually microbes, into water, carbon dioxide, and biomass. Biodegradable are commonly produced with renewable raw materials, micro-organisms, petrochemicals, or combinations of all three.



3. Non-bio-degradable

A Non-Biodegradable material can be defined as a kind of substance which cannot be broken down by natural organisms and acts as a source of pollution.

Unlike biodegradable wastes, non-biodegradable cannot be easily handled. Non-biodegradable wastes are those cannot be decomposed or dissolved by natural agents. They remain on earth for thousands of years without any degradation.

B. Treatment of waste materials

Sorting and treating waste allows it to be further processed into reusable materials, thereby maximizing the savings of primary resources and energy as well as reducing environmental burdens. This process is referred to as recycling, a key component in modern waste reduction hierarchy "Reduce, Reuse, Recycle ".

When people think about solid waste management, they likely associate it with garbage being dumped in landfills or incinerated. While such activities comprise an important part of the process, a variety of elements is involved in the creation of an optimal integrated solid waste management (ISWM) system. For example, treatment techniques act to reduce the volume and toxicity of solid waste. These steps can transform it into a more convenient form for disposal. Waste treatment and disposal methods are selected and used based on the form, composition, and quantity of waste materials.

Thermal Treatment

Thermal waste treatment refers to the processes that use heat to treat waste materials. *Incineration* is one of the most common waste treatments. This approach involves the combustion of waste material in the presence of oxygen. This thermal treatment method is commonly used as a means of recovering energy for electricity or heating. This approach has several advantages. It quickly reduces waste volume, lessens transportation costs and decreases harmful greenhouse gas emissions



Dumps and Landfills

Sanitary landfills provide the most commonly used waste disposal solution. These landfills are desired to eliminate or reduce the risk of environmental or public health hazards due to waste disposal. These sites are situated where land features work as natural buffers between the environment and the landfill. For instance, the landfill area can be comprised of clay soil which is quite resistant to hazardous wastes or is characterized by an absence of surface water bodies or a low water table, preventing the risk of water pollution.

Biological Waste Treatment

Composting is another most frequently used waste disposal or treatment method which is the controlled aerobic decomposition of organic waste materials by the action of small invertebrates and microorganisms. The most common composting techniques include static pile composting, vermin-composting, windrow composting and in-vessel composting.

L O 3.2: Arrange tools and materials according to their types

• Topic 1: Tools, materials and equipment used to clean the workplace

1. Vacuum cleaner

A vacuum cleaner, also known simply as a vacuum or a hoover, is a device that causes suction in order to remove debris from floors, upholstery, draperies and other surfaces. It is generally electrically driven. The debris is collected by either a dust bag or a cyclone for later disposal.



2. Lags or cotton waste

Lags or cotton waste prevents unwanted wastage and can be a more sustainable alternative to disposal. Because waste cotton is often already dyed, re-dyeing may not be necessary. Cotton is an extremely resource-intense crop in terms of water, pesticides and insecticides. This means that using recycled cotton can lead to significant savings of natural resources and reduce pollution from agriculture.





3. Cleaning solutions

Cleaning solutions are substances (usually liquids, powders, sprays, or granules) used to remove dirt, including dust, stains, bad smells, and clutter on surfaces. Purposes of cleaning solution include health, beauty, removing offensive odor, and avoiding the spread of dirt and contaminants to oneself and others. Some cleaning agents can kill bacteria (e.g. door handle bacteria, as well as bacteria on worktops and other metallic surfaces) and clean at the same time. Others, called degreasers, contain organic solvents to help dissolve oils and fats



4. Brush

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.



• Topic 2: Collection and arrangement of tools and equipment

Collection is the accumulation of tools and equipment in their correct location, especially for storage or as a result of some process after work. Arrangement of tools and equipment is to move and organize tools and equipment into a particular order or position to avoid the disorder in the working place.

Management as well as the practices in repairing audio amplifier to avoid indisposed of tools and equipment in the workplace. Arranging tools and equipment "involves adding each tool or equipment to the existing tools and equipment for better future use and well maintained. 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 collet, and a tool holder with a machine taper. Putting the parts together accurately into an assembly is required. Logistics deals with demand planning, supplies and tool location. This includes, on one hand, the location in the warehouse and the purchasing of individual parts with the corresponding consumption report. It also allows for the planning and coordination of the movements of tools and equipment within workplace.



Page 62 of 91

Topic 3: Arrangement of non-used materials (consumables)

Logistics deals with demand planning, supplies and consumable location. This includes, on one hand, the location in the warehouse and the purchasing of individual consumable with the corresponding consumption report. It also allows for the planning and coordination of the movements of non-used materials (consumable) within workplace. For future use and well-kept in the workplace.



a. 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. Use effective guarding methods that prevent a chip or particle (of any size) from being blown into the eyes or unbroken skin of the operator or other workers nearby. You may

Page **63** of **91**

also use barriers, baffles, or screens to protect other workers near the operator if there is a risk of exposure. In addition, air guns should also be used with some local exhaust ventilation or facilities to control the generation of airborne particulates. When compressed air cleaning is unavoidable, hazards can be reduced by making adjustments to the air gun such as:

- Chip guards or curtains that can deflect flying dust or debris,
- Extension tubes that provide the worker a safer working distance, or
- Air guns equipped with injection exhausts and particle collection bags.

b. 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.



c. Toweling

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





II. Tools used in cleaning

1. Brush

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.





The definition of a sponge is 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 or what a doctor uses in surgery to clean a wound.





3. Soft clothing

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.



• Topic 5: Waste materials management

A. Types of waste materials

1. Recyclable

Recycling is the process of converting waste materials into new materials and objects. The recyclability of a material depends on its ability to reacquire the properties it had in its virgin or original state. It is an alternative to "conventional" waste disposal that can save material and help lower greenhouse gas emissions. Recycling can prevent the waste of potentially useful materials and reduce the consumption of fresh raw materials, thereby reducing: energy usage, air pollution and water pollution. Recyclable materials include many kinds of glass, paper, cardboard, metal, plastic, tires, textiles, batteries, and electronics.

2. Bio-degradable

Biodegradable are that can be decomposed by the action of living organisms, usually microbes, into water, carbon dioxide, and biomass. Biodegradable are commonly produced with renewable raw materials, micro-organisms, petrochemicals, or combinations of all three.



3. Non-bio-degradable

A Non-Biodegradable material can be defined as a kind of substance which cannot be broken down by natural organisms and acts as a source of pollution.

Unlike biodegradable wastes, non-biodegradable cannot be easily handled. Non-biodegradable wastes are those cannot be decomposed or dissolved by natural agents. They remain on earth for thousands of years without any degradation.

B. Treatment of waste materials

Sorting and treating waste allows it to be further processed into reusable materials, thereby maximizing the savings of primary resources and energy as well as reducing environmental burdens. This process is referred to as recycling, a key component in modern waste reduction hierarchy "Reduce, Reuse, Recycle ".

When people think about solid waste management, they likely associate it with garbage being dumped in landfills or incinerated. While such activities comprise an important part of the process, a variety of elements is involved in the creation of an optimal integrated solid waste management (ISWM) system. For example, treatment techniques act to reduce the volume and toxicity of solid waste. These steps can transform it into a more convenient form for disposal. Waste treatment and disposal methods are selected and used based on the form, composition, and quantity of waste materials.

Thermal Treatment

Thermal waste treatment refers to the processes that use heat to treat waste materials. *Incineration* is one of the most common waste treatments. This approach involves the combustion of waste material in the presence of oxygen. This thermal treatment method is commonly used as a means of recovering energy for electricity or heating. This approach has several advantages. It quickly reduces waste volume, lessens transportation costs and decreases harmful greenhouse gas emissions.



Dumps and Landfills

Sanitary landfills provide the most commonly used waste disposal solution. These landfills are desired to eliminate or reduce the risk of environmental or public health hazards due to waste disposal. These sites are situated where land features work as natural buffers between the environment and the landfill. For instance, the landfill area can be comprised of clay soil which is quite resistant to hazardous wastes or is characterized by an absence of surface water bodies or a low water table, preventing the risk of water pollution.

H Biological Waste Treatment

Composting is another most frequently used waste disposal or treatment method which is the controlled aerobic decomposition of organic waste materials by the action of small invertebrates and microorganisms. The most common composting techniques include static pile composting, vermin-composting, windrow composting and in-vessel composting.

L O 3.3: Manage waste materials according to their types

• Topic 1: Tools, materials and equipment used to clean the workplace

1. Vacuum cleaner

A vacuum cleaner, also known simply as a vacuum or a hoover, is a device that causes suction in order to remove debris from floors, upholstery, draperies and other surfaces. It is generally electrically driven. The debris is collected by either a dust bag or a cyclone for later disposal.



2. Lags or cotton waste

Lags or cotton waste prevents unwanted wastage and can be a more sustainable alternative to disposal. Because waste cotton is often already dyed, re-dyeing may not be necessary. Cotton is an extremely resource-intense crop in terms of water, pesticides and insecticides. This means



that using recycled cotton can lead to significant savings of natural resources and reduce pollution from agriculture.



3. Cleaning solutions

Cleaning solutions are substances (usually liquids, powders, sprays, or granules) used to remove dirt, including dust, stains, bad smells, and clutter on surfaces. Purposes of cleaning solution include health, beauty, removing offensive odor, and avoiding the spread of dirt and contaminants to oneself and others. Some cleaning agents can kill bacteria (e.g. door handle bacteria, as well as bacteria on worktops and other metallic surfaces) and clean at the same time. Others, called degreasers, contain organic solvents to help dissolve oils and fats



4. Brush

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.



Topic 2: Collection and arrangement of tools and equipment

Management as well as the practices in repairing audio amplifier to avoid indisposed of tools and equipment in the workplace. Arranging tools and equipment "involves adding each tool or equipment to the existing tools and equipment for better future use and well maintained. 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 collet, and a tool holder with a machine taper. Putting the parts together accurately into an assembly is required. Logistics deals with demand planning, supplies and tool location. This includes, on one hand, the location in the warehouse and the purchasing of individual parts with the corresponding consumption report. It also allows for the planning and coordination of the movements of tools and equipment within workplace.



• Topic 3: Arrangement of non-used materials (consumables)

Logistics deals with demand planning, supplies and consumable location. This includes, on one hand, the location in the warehouse and the purchasing of individual consumable with the



corresponding consumption report. It also allows for the planning and coordination of the movements of non-used materials(consumable) within workplace. For future use and well-kept in the workplace.



• Topic 4: Cleaning of working area

Cleaning techniques

Cleaning is the process of removing unwanted substances, such as dirt, infectious agents, and other impurities, from an object or environment as workshop.

Cleaning is the most important and primary aspect of **workshop**. It is a process of removing dirt, dust and grime by using **methods** such as dusting, shaking, sweeping, mopping, **washing** or polishing.

Cleaning is broadly achieved through mechanical action and/or solvent action; many methods rely on both processes.

• Washing, usually done with water and often some kind of soap or detergent



- Pressure washing, using a high-pressure stream of water
- Abrasive blasting, typically used to remove bulk material from a surface, may be used to remove contaminants as well
- Dry cleaning of clothing and textiles, using a chemical solvent other than water
- Wet cleaning, methods of professional laundering that avoid the use of chemical solvents

Topic 5: Waste materials management

Introduction

Waste (or wastes) are unwanted or unusable materials. Waste is any substance which is discarded after primary use, or is worthless, defective and of no use. A by-product by contrast is a joint product of relatively minor economic value. A waste product may become a by-product, joint product or resource through an invention that raises a waste product's value above zero.

Types of waste materials (recyclable, bio-degradable, non- bio-degradable)

Introduction

Waste is defined as unwanted and unusable materials and is regarded as a substance which is of no use. Waste that we see in our surroundings is also known as garbage. Garbage is mainly considered as a solid waste that includes wastes from our houses (domestic waste), wastes from schools, offices, etc. (municipal wastes) and wastes from industries and factories (industrial wastes).

a) Biodegradable waste

These are the wastes that come from our kitchen and it includes food remains, garden waste, etc. Biodegradable waste is also known as moist waste. This can be composted to obtain manure. Biodegradable wastes decompose themselves over a period of time depending on the material.


b) Non-biodegradable waste

These are the wastes which include old newspapers, broken glass pieces, plastics, etc. Nonbiodegradable waste is known as dry waste. Dry wastes can be recycled and can be reused. Nonbiodegradable wastes do not decompose by themselves and hence are major pollutants.

c) Recycling of Waste

Recycling of waste product is very important as this process helps in processing waste or used products into useful or new products. Recycling helps in controlling air, water, and land pollution. It also uses less energy. There are a number of items that can be recycled like paper, plastic, glass, etc. Recycling helps in conserving natural resources and also helps in conserving energy. Recycling helps in protecting the environment as it helps in reducing air, water, and soil pollution.

Treatment of waste materials

Waste treatment refers to the activities required to ensure that waste has the least practicable impact on the environment. In many countries various forms of waste treatment are required by law.

Whether it is biodegradable or non-biodegradable, they harm human life and ruin other organisms and their environment. Thus, a proper treatment of wastes has to be done. This is not only the responsibility of the Government, but of every individual as well. The three Rs- Recycle, Reuse, and Reduce are the simplest steps which can be followed by each person to do their part. This can save energy and other resources as well. Another step is separate biodegradable from non-biodegradable at home and disposes of them separately.



Learning unit 4: Elaborate the report and invoice

LO 4.1: Identify elements of the report

• Topic 1: Elaboration of the repair report

Repair report: is a document that describes in detail the correct repairing procedures. When you **write** a repair report, it must be kept organized and detailed.

A repair report is written for a clear purpose and to a particular audience. Specific information and evidence are presented, analyzed and applied to a particular problem or issue.

- i. Elements of the repair report
 - Business full address: is the official location of a company's premises. It could be anything from someone's home address right up to a multi-million-pound campus, such as those big tech companies favor and everything in between.
 - ✓ Introduction: is a beginning section which states the purpose and goals of the following writing. This is generally followed by the body and conclusion. The introduction typically describes the scope of the document and gives the brief explanation or summary of the document.
 - Body: is a detailed discussion of your work for those readers who want to know in some depth and completeness what was done. The body of the report shows what was done, how it was done, what the results were, and what conclusions and recommendations can be drawn.
 - Conclusion/recommendation: The conclusion enables you to reinforce the main messages of the document. A conclusion summarizes the report as a whole, drawing inferences from the entire process about what has been found, or decided, and the impact of those findings or decisions.



ii. Format of the repair report



• Topic 2: Elaboration of the invoice.

Invoice: is a sort of bill, displaying the amount due to the buyer. **Invoice** is used for confirmation of sale.

A standard invoice is issued by a business and submitted to a client. This is the most common form of invoice that small businesses create and the format is flexible enough to fit most industries and billing cycles. Standard invoices include the following details about the sale:



- The business's name and contact information
- The client's name and contact information
- An invoice number
- The amount of money the client owes the business for its services

a) Elements of the invoice

- ✓ Business name
- ✓ Tin number
- ✓ Company name and address
- ✓ Customer bank account
- ✓ Item number
- ✓ Item name
- ✓ Item specification
- ✓ Item quantity
- ✓ Item unit price and item total price

b) Format of the invoice

[Your Company Name] [Your Company Slogan]

INVOICE

INVOICE #[100] DATE: 27 SEPTEMBER 2016

[Street Address] [City, ST ZIP Code] Phone [(509) 555-0190] Fax [(509) 555-0191] TO: [Name] [Company Name] [Street Address] [City, ST ZIP Code] [Phone]

FOR: [Project or service description] [P.O. #]

DESCRIPTION	HOURS	RATE	AMOUNT
		TOTAL	

Make all checks payable to [Your Company Name] Total due in 15 days. Overdue accounts subject to a service charge of 1% per month.

Thank you for your business!



c) Cost estimation

A Cost estimate is a quantified expectation of how many resources are required to complete a project or parts of a project.

Such cost estimates are often expressed in currency units. However, other units such as mandays can also be used if the currency amounts are not applicable or irrelevant.

There are different types of cost estimates. The Project Management Body of Knowledge lists the rough order of magnitude (ROM) and the definitive estimate. Both types differ in respect of their accuracy, the project phases in which they are used as well as the available tools and techniques. Some projects use additional, sometimes industry-specific types of estimates.

Project Cost Estimation Techniques

All of these factors impact project cost estimation, making it difficult to come up with precise estimates. Luckily, there are techniques that can help with developing a more accurate cost estimation.

Analogous Estimating

Seek the help of experts who have experience in similar projects, or use your own historical data. If you have access to relevant historical data, try analogous estimating, which can show precedents that help define what your future costs will be in the early stages of the project.

Statistical Modeling

There is statistical modeling, or parametric estimating, which also uses historical data of key cost drivers and then calculates what those costs would be if the duration or another aspect of the project is changed.

Bottom-Up Estimating

A more granular approach is bottom-up estimating, which uses estimates of individual tasks and then adds those up to determine the overall cost of the project.



L O 4.2: Develop the repair report according to the repaired equipment

• Topic 1: Elaboration of the repair report

Repair report: is a document that describes in detail the correct repairing procedures. When you **write** a repair report, it must be kept organized and detailed.

A repair report is written for a clear purpose and to a particular audience. Specific information and evidence are presented, analyzed and applied to a particular problem or issue.

- i. Elements of the repair report
 - ✓ Business full address: is the official location of a company's premises. It could be anything from someone's home address right up to a multi-million-pound campus, such as those big tech companies favor and everything in between.
 - ✓ Introduction: is a beginning section which states the purpose and goals of the following writing. This is generally followed by the body and conclusion. The introduction typically describes the scope of the document and gives the brief explanation or summary of the document.
 - Body: is a detailed discussion of your work for those readers who want to know in some depth and completeness what was done. The body of the report shows what was done, how it was done, what the results were, and what conclusions and recommendations can be drawn.
 - Conclusion/recommendation: The conclusion enables you to reinforce the main messages of the document. A conclusion summarizes the report as a whole, drawing inferences from the entire process about what has been found, or decided, and the impact of those findings or decisions.



ii. Format of the repair report



siness Rules Template [Version Number]

V&V provides a systemation Reviews and tests are performed at the end of each phase of the development process to ensure requirements are complete. In the end of each phase of the development process to

data satisfy those requirements. The two major V&V aotivities are reviews (including inspections and walkthroughs) and testing.

Place the VB Growth in context by providing a bird introductory and describing those aspects of the problem and/or solution which influence the V&V needs and approach.

Sample ext



This plan is used to assess software products throughout the software development lifecycle, and ensure that the software satisfies functional requirements. The purpose of the plan is to provide a detailed process plan for the Verification and Validation of [system].



- Establish the proper basis for initiating the next life circle phase.
- Satisfy standards, manager, procedures, and conventions.



• Topic 2: Elaboration of the invoice.

Invoice: is a sort of bill, displaying the amount due to the buyer. **Invoice** is used for confirmation of sale.

A standard invoice is issued by a business and submitted to a client. This is the most common form of invoice that small businesses create and the format is flexible enough to fit most industries and billing cycles. Standard invoices include the following details about the sale:

- > The business's name and contact information
- > The client's name and contact information
- > An invoice number
- > The amount of money the client owes the business for its services

a) Elements of the invoice

- ✓ Business name
- ✓ Tin number
- ✓ Company name and address
- ✓ Customer bank account
- ✓ Item number
- ✓ Item name
- ✓ Item specification
- ✓ Item quantity
- ✓ Item unit price and item total price



b) Format of the invoice

[Your Company Name] [Your Company Slogan]

[Street Address] [City, ST ZIP Code] Phone [(509) 555-0190] Fax [(509) 555-0191]

TO: [Name] [Company Name] [Street Address] [City, ST ZIP Code] [Phone] FOR: [Project or service description] [P.O. #]

DESCRIPTION	HOURS	RATE	AMOUNT
		TOTAL	

Make all checks payable to [Your Company Name] Total due in 15 days. Overdue accounts subject to a service charge of 1% per month.

Thank you for your business!

c) Cost estimation

A Cost estimate is a quantified expectation of how many resources are required to complete a project or parts of a project.

Such cost estimates are often expressed in currency units. However, other units such as mandays can also be used if the currency amounts are not applicable or irrelevant.

There are different types of cost estimates. The Project Management Body of Knowledge lists the rough order of magnitude (ROM) and the definitive estimate. Both types differ in respect of their accuracy, the project phases in which they are used as well as the available tools and techniques. Some projects use additional, sometimes industry-specific types of estimates.

INVOICE

INVOICE #[100] DATE: 27 SEPTEMBER 2016

Page **81** of **91**

Project Cost Estimation Techniques

All of these factors impact project cost estimation, making it difficult to come up with precise estimates. Luckily, there are techniques that can help with developing a more accurate cost estimation.

Analogous Estimating

Seek the help of experts who have experience in similar projects, or use your own historical data. If you have access to relevant historical data, try analogous estimating, which can show precedents that help define what your future costs will be in the early stages of the project.

Statistical Modeling

There is statistical modeling, or parametric estimating, which also uses historical data of key cost drivers and then calculates what those costs would be if the duration or another aspect of the project is changed.

Bottom-Up Estimating

A more granular approach is bottom-up estimating, which uses estimates of individual tasks and then adds those up to determine the overall cost of the project.

L O 4.3: Develop the invoice according to the work done

• Topic 1: Elaboration of the repair report

Repair report: is a document that describes in detail the correct repairing procedures. When you **write** a repair report, it must be kept organized and detailed.

A repair report is written for a clear purpose and to a particular audience. Specific information and evidence are presented, analyzed and applied to a particular problem or issue

i. Elements of the repair report

✓ Business full address: is the official location of a company's premises. It could be anything from someone's home address right up to a multi-million-pound campus, such as those big tech companies favor and everything in between.



- ✓ Introduction: is a beginning section which states the purpose and goals of the following writing. This is generally followed by the body and conclusion. The introduction typically describes the scope of the document and gives the brief explanation or summary of the document
- Body: is a detailed discussion of your work for those readers who want to know in some depth and completeness what was done. The **body** of the **report** shows what was done, how it was done, what the results were, and what conclusions and recommendations can be drawn.
- Conclusion/recommendation: The conclusion enables you to reinforce the main messages of the document. A conclusion summarizes the report as a whole, drawing inferences from the entire process about what has been found, or decided, and the impact of those findings or decisions.

ii. Format of the repair report





• Topic 2: Elaboration of the invoice.

Invoice: is a sort of bill, displaying the amount due to the buyer. **Invoice** is used for confirmation of sale.

A standard invoice is issued by a business and submitted to a client. This is the most common form of invoice that small businesses create and the format is flexible enough to fit most industries and billing cycles. Standard invoices include the following details about the sale:

- > The business's name and contact information
- > The client's name and contact information
- > An invoice number
- > The amount of money the client owes the business for its services

a) Elements of the invoice

- ✓ Business name
- ✓ Tin number
- ✓ Company name and address
- ✓ Customer bank account
- ✓ Item number
- ✓ Item name
- ✓ Item specification
- ✓ Item quantity
- ✓ Item unit price and item total price



b) Format of the invoice

[Your Company Name] [Your Company Slogan]

[Street Address] [City, ST ZIP Code] Phone [(509) 555-0190] Fax [(509) 555-0191]

TO: [Name] [Company Name] [Street Address] [City, ST ZIP Code] [Phone] FOR: [Project or service description] [P.O. #]

DESCRIPTION	HOURS	RATE	AMOUNT
		TOTAL	

Make all checks payable to [Your Company Name] Total due in 15 days. Overdue accounts subject to a service charge of 1% per month.

Thank you for your business!

c) Cost estimation

A Cost estimate is a quantified expectation of how many resources are required to complete a project or parts of a project.

Such cost estimates are often expressed in currency units. However, other units such as mandays can also be used if the currency amounts are not applicable or irrelevant.

There are different types of cost estimates. The Project Management Body of Knowledge lists the rough order of magnitude (ROM) and the definitive estimate. Both types differ in respect of their accuracy, the project phases in which they are used as well as the available tools and techniques. Some projects use additional, sometimes industry-specific types of estimates.



INVOICE #[100] DATE: 27 SEPTEMBER 2016



Project Cost Estimation Techniques

All of these factors impact project cost estimation, making it difficult to come up with precise estimates. Luckily, there are techniques that can help with developing a more accurate cost estimation.

Analogous Estimating

Seek the help of experts who have experience in similar projects, or use your own historical data. If you have access to relevant historical data, try analogous estimating, which can show precedents that help define what your future costs will be in the early stages of the project.

Statistical Modeling

There is statistical modeling, or parametric estimating, which also uses historical data of key cost drivers and then calculates what those costs would be if the duration or another aspect of the project is changed.

Bottom-Up Estimating

A more granular approach is bottom-up estimating, which uses estimates of individual tasks and then adds those up to determine the overall cost of the project.

L O 4.4: Suitable development of invoice according to the work done

• Topic 1: Elaboration of the repair report

Repair report: is a document that describes in detail the correct repairing procedures. When you **write** a repair report, it must be kept organized and detailed.

A repair report is written for a clear purpose and to a particular audience. Specific information and evidence are presented, analyzed and applied to a particular problem or issue

i. Elements of the repair report

✓ Business full address: is the official location of a company's premises. It could be anything from someone's home address right up to a multi-million-pound campus, such as those big tech companies favor and everything in between.



- Introduction: is a beginning section which states the purpose and goals of the following writing. This is generally followed by the body and conclusion. The introduction typically describes the scope of the document and gives the brief explanation or summary of the document.
- Body: is a detailed discussion of your work for those readers who want to know in some depth and completeness what was done. The body of the report shows what was done, how it was done, what the results were, and what conclusions and recommendations can be drawn.
- Conclusion/recommendation: The conclusion enables you to reinforce the main messages of the document. A conclusion summarizes the report as a whole, drawing inferences from the entire process about what has been found, or decided, and the impact of those findings or decisions.

pany addres vare being Ventioation and Va V&V) is the process of ensuring that developed will so functional and other requirements and each st the process of building the soft are yield: -nfers to of the activities that ensure that e softwa V&V provides a sys associated products. Reviews and tests are p end of each pl evelopment process to ensure requirements are oo an, oode, dooumentation, and data satisfy those requireme The two major V&V activities are reviews (including inspections and walkthroughs) and testing. oontext by providing a bi introductory and describing those or solution which influence the V&V needs and approach. 050 Sample This pla is used to assess software products th oughout he software development lifecycle, the softwa<u>re</u> functional re ients. The purpose of the plan is to and ensu s plan for the Verification and Validation of [system]. provide a detailed b the mail of a Conds to col Desori 115 eve, such as: -С mply with previous life cycle phase requirements ablish the proper basis for initiating the next life gode phase. E ards, a wores, practices, procedures, and conventions. Satisfy stars

Page 87 of 91

ii. Format of the repair report

• Topic 2: Elaboration of the invoice.

Invoice: is a sort of bill, displaying the amount due to the buyer. **Invoice** is used for confirmation of sale.

A standard invoice is issued by a business and submitted to a client. This is the most common form of invoice that small businesses create and the format is flexible enough to fit most industries and billing cycles. Standard invoices include the following details about the sale:

- > The business's name and contact information
- > The client's name and contact information
- > An invoice number
- > The amount of money the client owes the business for its service

a) Elements of the invoice

- ✓ Business name
- ✓ Tin number
- ✓ Company name and address
- ✓ Customer bank account
- ✓ Item number
- ✓ Item name
- ✓ Item specification
- ✓ Item quantity
- ✓ Item unit price and item total price



b) Format of the invoice

[Your Company Name] [Your Company Slogan]

[Street Address] [City, ST ZIP Code] Phone [(509) 555-0190] Fax [(509) 555-0191]

TO: [Name] [Company Name] [Street Address] [City, ST ZIP Code] [Phone] FOR: [Project or service description] [P.O. #]

DESCRIPTION	HOURS	RATE	AMOUNT
		TOTAL	

Make all checks payable to [Your Company Name] Total due in 15 days. Overdue accounts subject to a service charge of 1% per month.

Thank you for your business!

c) Cost estimation

A Cost estimate is a quantified expectation of how many resources are required to complete a project or parts of a project.

Such cost estimates are often expressed in currency units. However, other units such as mandays can also be used if the currency amounts are not applicable or irrelevant.

There are different types of cost estimates. The Project Management Body of Knowledge lists the rough order of magnitude (ROM) and the definitive estimate. Both types differ in respect of their accuracy, the project phases in which they are used as well as the available tools and techniques. Some projects use additional, sometimes industry-specific types of estimates.



INVOICE #[100] DATE: 27 SEPTEMBER 2016



Project Cost Estimation Techniques

All of these factors impact project cost estimation, making it difficult to come up with precise estimates. Luckily, there are techniques that can help with developing a more accurate cost estimation.

Analogous Estimating

Seek the help of experts who have experience in similar projects, or use your own historical data. If you have access to relevant historical data, try analogous estimating, which can show precedents that help define what your future costs will be in the early stages of the project.

Statistical Modeling

There is statistical modeling, or parametric estimating, which also uses historical data of key cost drivers and then calculates what those costs would be if the duration or another aspect of the project is changed.

Bottom-Up Estimating

A more granular approach is bottom-up estimating, which uses estimates of individual tasks and then adds those up to determine the overall cost of the project.



References

- 1. M, S. (july 12,2018). *AutoAutomobile engg_ Common problems of cooling system.* wikiHow.
- 2. sherber, C. (may 06, 2010). *Elecrical & ElectronicsHome Electronics & AutomationHome Entertainment & Cable.* wikiHow.
- 3. staff, w. (JULY 1,2019). COMPUTERS AND ELECTRONICSAUDIO. *How to troubleshoot an amp.*
- 4. surbhi. (08/03/2016). *Profoma invoice and invoice*.
- 5. THOMSON REUTERS. (2013). *Practicallaw*. UK: onchor.
- 6. Yusop, A. (n.d.). *ELECTRONIC EQUIPMENT REPAIR CHAPTER 5 (EE302 AUDIO AMPLIFIER).* www.academia.edu.

Note:

Many contents in this manual are duplicated more than two times due to how the curriculum was developed and arranged.

