MAINTENANCE AND REPAIRS OF ELECTRONICS AND SCIENCE LAB. EQUIPMENTS

STP 221
INTRODUCTION

- Any electronic instrument or piece of equipment can be considered as a system.
- A system is anything formed of component parts connected together to make a complete whole.
- An instrument or piece of equipment can have sub-systems made in blocks.
- Failure of a component in an equipment may lead to the failure of the system.
- Failure is said the inability of a system to perform its required function.
- The need for continuous performance of an equipment requires regular Maintenance.
MAINTENANCE

• All activities carried out on an equipment which includes:
  • Proper Installation
  • Good servicing
  • Routine checks
  • Replacement of faulty parts
• All in order for such equipment to operate at its maximum output put through out its useful is known as maintenance.
failure

• When a system becomes completely inoperative
• When still operational but unable to perform the required function
• When it become unsafe for its continued use
Classification of maintenance

• PREVENTIVE MAINTENANCE: Practice where by a piece of equipment or instrument are regularly checked, oiled, greased or cleaned according to manufacturers specification for effective performance

• CORRECTIVE MAINTENANCE: This is a method that is applied to a system that has failed and broken down due to either improper operation or defective parts.
MAINTENANCE STRATEGY

• A plan or scheme put in place by personnel responsible for maintenance to ensure that the exercise is effectively carried out.

• TYPES OF MAINTENANCE:
  • Fixed time Maintenance
  • Condition Based Maintenance
  • Opportunity Based Maintenance
  • Design out Maintenance
  • Operate to Failure Maintenance
PLANNED MAINTENANCE SCHEME

• This is a strategy that is put in place to ensure that all equipment receive the most appropriate type of maintenance at the right time.

• Planned maintenance policy for any organization must be carefully considered and planned in advance.

• It must include records which are compiled and maintained to measure the result of maintenance and serve as a guide to future planning.
ESTABLISHING A PLANNED MAINTENANCE SCHEME

• Take inventory of all items to be maintained. Reference each item with a letter to indicate its location.
• Describe the maintenance task which are to be performed.
• Finally, wherever any maintenance is carried out on a piece of equipment a record of what has been done must be kept.
• This may be a form of job report specifying date, fault detected and fault.
EQUIPMENT FAILURE

• An equipment is made up of electronic components or a combination of electronic and electromechanical parts.

• When a component fails or a part is damaged it leads to a failure of the equipment or system.

• The failure rate of an equipment may be influenced by different weighting factors, depending on the environmental and operating conditions’
ENVIRONMENTAL STRESSES

- Environmental stresses on equipment may be due to effect of factors which are external, such as:
  - Weather
  - Atmospheric pressure
  - Wind
  - Temperature
  - Humidity
  - Sea water.
MEASURING INSTRUMENTS

- Multimeter is an electrical/electronics measuring instrument, Multimeter is a combination of different measuring instruments which includes:
  - Ammeter
  - Voltmeter
  - Ohmmeter
  - All used for measuring the following quantities
  - Current
  - Voltage
  - Resistance
  - The Oscilloscope is basically a graph displaying device
DIFFERENT TYPES OF MULTIMETER

• Digital Multimeter, have a numerical display and have battery to power the display, so the use virtually no power from the circuit under test.

• Analogue Multimeter uses a microammeter with a pointer to display reading, it takes little power from the circuit under test to operate the pointer.
SOME BASIC SERVICING TOOLS

• Wire Cutters, Clippers, Nippers
• Soldering Iron
• Screw Drivers
• Spanners
• Allen Keys
RESISTORS

- Resistance is an electrical quantity, resistivity is a physical property of materials, which is used to produce resistance
DIFFERENT TYPES OF RESISTORS
INDUCTOR

• An inductor is a passive electrical device that stores energy in a magnetic field, typically by combining the effects of many loops of electric current.
Inductors
CAPACITORS

- Capacitors store electric charge.
- They are used with resistors in timing circuits because it takes time for a capacitor to fill with charge.
- They are used to smooth varying DC supplies by acting as a reservoir.
- They are also used in filter circuits because capacitors easily pass AC (charging) signal but they block DC (constant) signals.
Capacitors
DIODES

• Diodes allow electricity to flow in only one direction.
• The arrow of the circuit symbol shows the direction in which the current can flow.
• Diodes are the electrical version of a valve and early diodes were actually called valves.
Diodes
TRANSISTORS

- The **transistor is a solid state semiconductor device** which can be used for amplification,
- switching, voltage stabilization,
- signal modulation and many other functions.
- It acts as a variable valve which, based on its
  - input current (BJT) or input voltage (FET).
Transistors
RESISTOR COLOUR CODES

• In former times all resistors were labeled with figures indicating their values. These figures were substituted by color rings which indicate the value and the tolerance. The reasons were:
  • Cheaper application of the labeling
  • Increasing miniaturization left no room for figures
  • Figures cannot be read when on the bottom side of the element.
• The international color code defines the corresponding values of each color.

• Values with a tolerance between 20% and 5% can be specified by 2 significant numbers.

• Therefore such resistors will have two color rings for the value one color ring for the multiplier one color ring for the tolerance (none for 20%). **5% and 10% tolerance resistors have 4 color rings.**
COMPONENTS  TESTING USING MULTIMETER

- **Measuring Resistance Value**
- To measure resistance you must connect the test leads to the sockets labelled 'COM' and 'Ω'.
- Adjust the function selector switch to measure Resistance **Ohms (Ω)**.
- Without anything connected between the test leads the display will give an out of range indication (1 or OL) to show that the resistance is too large to measure or open circuit. probes are not connected to circuit)
- To check the meter is working touch the leads together and the display should read 0.0 Ω. It may read slightly higher, e.g. 0.3 Ω.
- This is the resistance of the test leads themselves. Connect the probes of the multimeter across a resistor and measure the resistance as shown in the next slide
MEASUREMENT OF DIODES

Diodes can have 4 different faults.
1. Open circuit in both directions.
2. Low resistance in both directions.
3. Leaky.
4. Breakdown under load.
TRANSISTOR TESTING

• Testing a transistor with a **Digital Meter** must be done on the "DIODE" setting as a digital meter does not deliver a current through the probes on some of the resistance settings and will not produce an accurate reading. The "DIODE" setting must be used for diodes and transistors. It should also be called a "TRANSISTOR" setting.
• TESTING AN unknown TRANSISTOR
The first thing you may want to do is test an unknown transistor for COLLECTOR, BASE AND EMITTER. You also want to perform a test to find out if it is NPN or PNP. That's what this test will provide.
SOLDERING TECHNIQUE

• The Basic Soldering Guide

• Soldering is a delicate manual skill which only comes with practice. Remember that your ability to solder effectively will determine directly how well the prototype or product functions during its lifespan. Poor soldering can be an expensive business - causing
  • product failure and downtime, engineer's maintenance time and customer dissatisfaction.
  • old, dirty parts; these can be difficult if not impossible to solder.
CIRCUIT BOARDS

• These are used in design and development of circuits. Since components are laid out in the same way as the circuit diagram, it is a simple matter to trace components and alterations can be easily made.

• Draw a grid on a piece of paper. The distance between the line intersections should be the same as the distance between holes on the matrix board.

• Draw the components to scale on to the grid, marking the positions of any terminal pins. The appearance of the drawing should be similar to the circuit diagram.
CENTRIGUGE

• Centrifugation is one of the methods used for separation of liquid mixtures of substances e.g. colloidal substances or any liquid suspension. Centrifuge is the mechanical device that employs concept of centrifugation.

• A centrifuge is made up of the following mechanical parts. Such as:
• A big chamber housing a rotor with a rotor head firmly fixed to its top.
• A set of centrifuge tubes/cups arranged in a specific order on the rotor head.
• A massive lid to close the chamber when the instrument is being used.
• Some centrifuges have devices for measuring the speed of the moving rotor (Tacometer).
• A Speed control device
• A timer.
OPERATIONAL GUIDELINES

• With the instrument unplugged from the mains socket.
• Return speed control knob and the timer to zero setting
• Select the appropriate rotor head to use and fix it firmly on the rotor.
• Weigh the centrifuge cups/tubes and balance them up to give equal weights
• Always use the recommended tubes that the manufacturers sent along with the instrument
• Measure out equal volumes of test samples into the tubes using a calibrated pipette.
• Arrange the cups/tubes on the rotor head such that equal numbers are made to face each other to balance the weight.
• Close the lid tightly.
• Plug the instrument to the mains and switch on the power.
• Turn on timer to desired time.
• Starting from low speed gradually increase the speed to desired limit.
• At the end of centrifugation when the instrument switches off by itself, allow the speed meter to return to zero.
• Unplug the instrument, open the lid and bring out centrifuge tubes and decant supernatant solution.
• The solid residue at the bottom of the cups can also be removed.
• Clean the cups properly and arrange them neatly to dry in their containers.
• Clean the centrifuge inner chamber first with wet duster and then with dry one.
MAINTENANCE

• Centrifuge tubes should be handled with care to prevent them from being knocked against hard objects that can inflict dents on them.

• Rotor head should always be securely screwed tight to the rotor.

• Centrifuge should not be placed on the same work-bench with other sensitive instruments to prevent transmission of vibration from it to them.

• The instrument lid should be shut before the instrument is connected to the mains and the lid should not be opened while instrument is still spinning.
• Centrifuge always should be covered with a dust cover made from white cloth and not polythene material.
• Electrical fuse of correct rating should always be used on the electrical plug to prevent damage to the instrument.
• The uninterrupted power supply (UPS) should always be used on the electrical plug to prevent damage to the instrument.
• Centrifuge tubes should not be filled to the brim with test samples to prevent spillage on the inner chamber of the instrument.
• Centrifuge tubes should be handled with care to prevent them from being knocked against hard objects that can inflict dents on them.

• Rotor head should always be securely screwed tight to the rotor.

• Centrifuge should not be placed on the same work-bench with other sensitive instruments to prevent transmission of vibration from it to them.

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STIRRERS

• Mechanical Stirrer motor
• Single Stirrer motor
• Multi Stirrer
OPERATIONAL GUIDELINES

- Set timer of the instrument to zero and motor at off.
- Weigh 5gm sample into each of the cups arranged on aluminum tray.
- Add 25ml of extracting solution e.g. IN neutral Ammonium Acetate to each of the cups with a dispenser.
- Place sample tray below the stirrer blades with the aid of a metal handle at the right hand side of the aluminum gadget. There is a click sound when right position is reached.
- Move sample tray up to meet the stirrer blades with the aid of a metal handle at the right side of the aluminum gadget. There is a click sound when right position is reached.
- Through a 240V – 115V step-down transformer, connect the instrument to the mains power supply.
- Set timer to 15 minutes and switch on the motor.
- At the expiration of 15 minutes, the instrument switches off automatically.
- Lower the sample cups and filter samples into clean containers.
- Rinse off soil particles from the stirrer blades properly with distilled water.
- Switch off the motor and disconnect instrument from the power supply.
MAINTENANCE

- As water is a good conductor of electricity, no liquid substance should be allowed to get into the electric motor.
- Water causes short circuiting which can lead to the damage of the motor.
- It can also cause electrocution of the user.
- In the case of a multi-stirrer, the stirrer blades are made of plastic material and therefore fragile. It should always be gently treated.
- It should always be covered by dust cover made of white cloth.
- The instrument should be cleaned before and after use.
- No other cups should be used as a substitute for the recommended ones for a particular stirrer.
- Do not spin without a stirrer cup lest an innocent somebody passing by, perhaps holding a duster or cloth gets hooked by the moving blades thereby inflicting injuries on him and damage to the instrument.
- The electric motor should be occasionally opened to be cleaned of dust and spider webs that can cause break in electrical contacts.
- Where Boris is used, occasional greasing or oiling is necessary.
- Mechanical stirrers should not be operated near a hot object or environment as the magnet inside the motor get destroyed under such condition.
- Instrument should be kept in an air-conditioned instrument room properly fortified to prevent burglary or theft.
SHAKERS

• Shakers are equipments used in soil and plant laboratory to either mix or separate solutions.
• The kind to use depends on what is to be done.
  ▪ Examples:
  ▪ Test Tube Shakers
  ▪ Magnetic Shakers
  ▪ Homogenizer
  ▪ Mixer
OPERATION

- Shakers should be placed on a level and smooth surface so that it stands firm.
- This is very important to prevent spilling during operation at high shaking frequencies.
- **For Orbital Shakers, when working with Petri dishes or object slides, the clamping strips should** be removed.
- Always adjust the speed control to minimum shaking frequency before putting the device into operation by actuating the mains switch.
- When this is done, the drive is treated gently and possible spilling of liquid from sudden motion is prevented.
- The speed control can then be adjusted to desired speed.
- Having completed the shaking process, the speed control is then turned back to minimum frequency and the mains switch (ON - OFF Switch) turned off.
• REFERENCE

• Unesco- Nigeria Technical and Vocational Education Revitalization project- phase II