CHAPTER THREE

3.1 DESIGN AND METHODOLOGY

This chapter deals with the entire procedures and designs involved in the design of all the electrical/electronic component of Single-phase transformer trainer.

3.2 SINGLE PHASE TRANSFORMER TRAINER

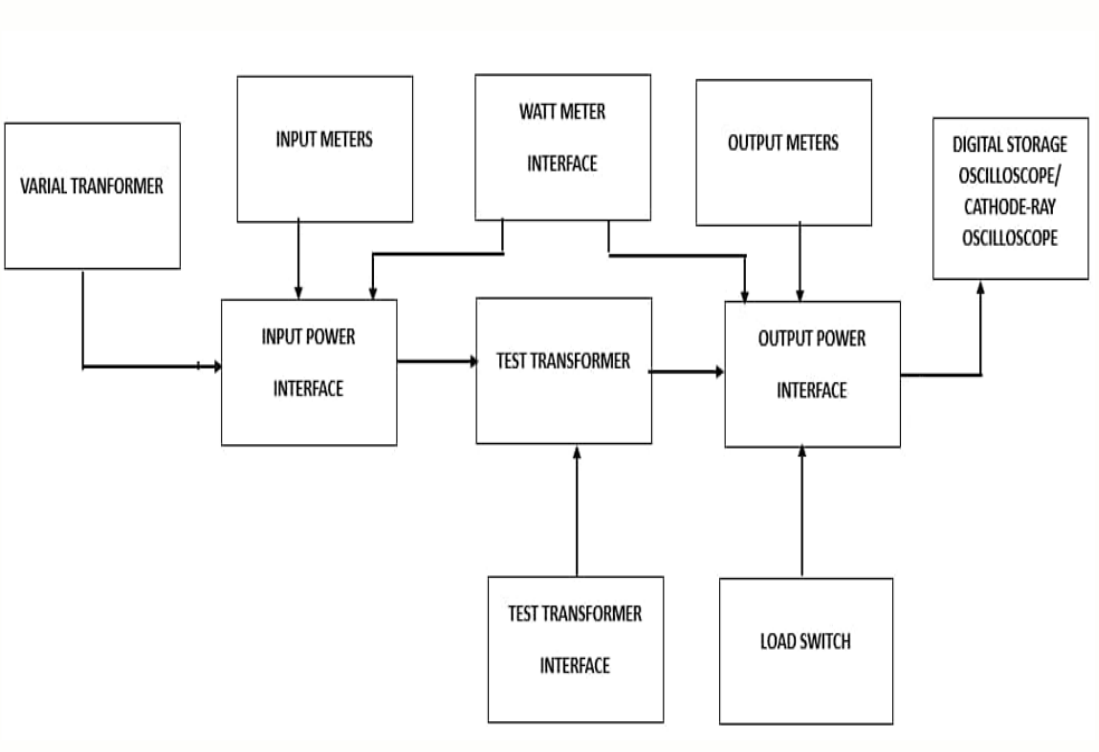

Figure 3.1: Block diagram of a single-phase transformer trainer
Source: Engineering World (2019).

3.2.1 Power Supply

The power supply in the mother board is to supply a voltage of 5V DC to the LCD display on the transformer trainer. This task is accomplished by rectifying AC to DC and then smoothening the rectified voltage to remove AC ripples before it is regulated to 5V using IC voltage regulator.

The power supply supplies 12v and 2A by using two voltage regulators connected in parallel. It also supplies 5v for powering the LCD and the current sensor. In achieving this, the power from the authorities has to be stepped down, filtered and regulated. The power supply unit consist of the following components:

i. Transformer

ii. The rectifier circuits

iii. Smoothing capacitor

iv. The regulators

3.2.2 Output

The output from the trainer is connected to LCD to display the result of various experiment performed on the trainer. The trainer and the LCD are linked via the digital pin on the Arduino board.

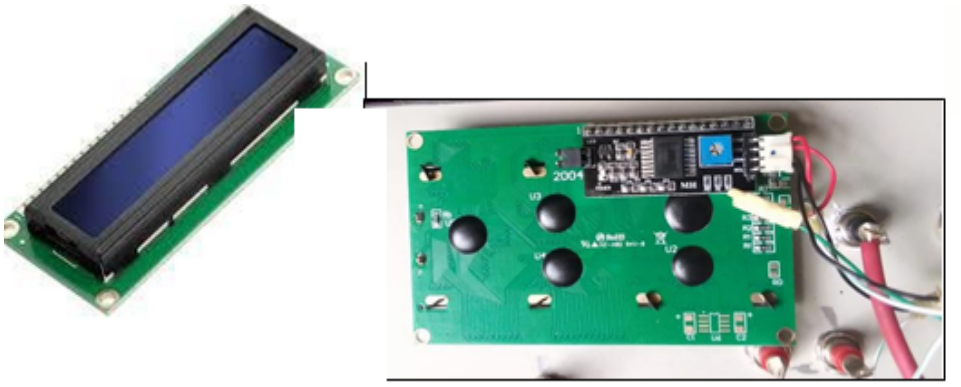

Figure 3.2: Output Digital Display
Source: Raj, Aswinth (2015)

3.2.3 Wire Selection

The selection of SWG (Standard Wire Gauge) wire in a transformer is a critical aspect of transformer design, particularly for the winding of coils. The wire gauge chosen impacts various transformer characteristics such as resistance, current-carrying capacity, and space utilization The SWG of the wire should be chosen to handle the expected current in the winding without excessive heating. Higher SWG values indicate thinner wire, which may have lower current-carrying capacity.

Primary current $Ip = 4A$

Secondary current = 2A

Using table; Primary Winding = 17 SWG

Secondary Winding =19 SWG

3.2.4 Insulation

Insulation materials are crucial in transformers to prevent electrical breakdown and ensure the safe and reliable operation of the device. The insulation between primary and secondary windings is essential to avoid short circuits and maintain the electrical integrity of the transformer. We have used paper binding tape for the purpose as shown in the figure below.

Figure 3.3: Paper Binding Tape

3.2.5 Core sheets

Inserting core E sheets is the next step in the construction of the core of a transformer. The core E sheets, typically made of laminated silicon steel, form the magnetic circuit that allows the efficient transfer of magnetic flux. These lamination stampings when connected together form the required core shape. For example, two “E” stampings plus two end closing “I” stampings to give an E-I core forming one element of a standard shell-type transformer core. These individual laminations are tightly butted together during it’s construction to reduce the reluctance of the air gap at the joints producing a highly saturated magnetic flux density.

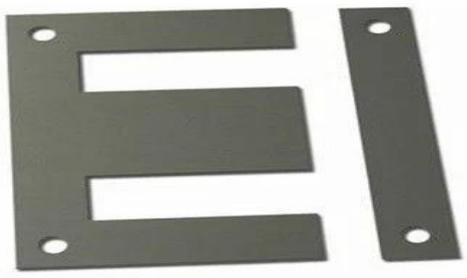

Figure 3.4: The Core E and I Sheet

3.2.6. SOLDERING AND ARRANGEMENT OF COMPONENTS

Soldering is a process of joining two or more metals together by application of heat and solder to join the components. Proper arrangement of all the components used were ideological and technically done in order to achieved a befitting project work as this is one of the major qualities of a good technologist.

3.3 ASSEMBLING OF A SINGLE-PHASE TRANSFORMER

3.3.1 Frame Construction

The trainer is enclosed in a square shape cast wooden frame with a vertical

position slightly bent backwards. The meters are mounted on a vertical section while the mimic diagram data is covered with vanished ½ plywood board screwed into the meter frame. The front panel where the meters are mounted is covered with velvet cloth to enhance its ecstatic. The trainer frame rests on four legs, the material for the Trainer construction was chosen with the utmost regard to their reliability, durability, maintainability and readability attributes.

3.3.2 Procedures for the construction of the single-phase transformer trainer

The procedures for the construction of the transformer trainer are as follow;

1. The wooden frame is first cut into require size of 60cm by 43cm by 58cm to form a skeletal frame of how the trainer will look like.
2. The pointed board of the transformer shows the parameters of the transformer circuit to required shape and length.
3. The placing of the sockets at the relevant areas to show the current, voltage and power is done by the drilling to give the reading for the connection to the ammeter, voltmeter and wattmeter of the board.
4. Wiring of the socket after drilling is done so that the readings can be shown at the ammeter and voltmeter.
5. Placing the ammeter, voltmeter, circuit breaker and toggle switch was done at their respective position.
6. The wiring was done in such a way that a return path was made so that a complete circuit was established.
7. After the connection of the equipment it is then wrapped with suitable leather to give it ecstatic

Figure 3.5: Transformer circuit board internal connection

Figure3.6: Front view of a Single Phase Trainer