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**EMS**

**LAB REPORT 2**

**EXPERIMENT 2**

**(A) CONSTRUCTION OF TRANSFORMER**

**(B) CONSTRUCTION OF AUTOTRANSFORMER**

**EQUIPMENT:**

* Winding machine Single
* Bobbin
* Iron core stampings
* Insulating paper
* Laminated copper wire
* Nuts and bolts

**INTRODUCTION:**

**TRANSFORMER:**

A transformer is a device that converts one AC voltage to another. It’s simply a device used for either stepping-up or stepping down an applied input AC through magnetic induction in between its two windings.

Basically, a transformer will have the following main components:

* Iron core stampings (configured either as U/T or E/I, generally the latter is used more extensively).
* Central plastic or ceramic bobbin surrounded by the above iron core stampings.
* Two windings (electrically isolated and magnetically coupled) using super enameled copper wire made over the bobbin.
* Normally the winding which is designated to receive the input supply is termed as the “Primary” and the winding which in response to this input produces the required induced voltage as the output is termed as the “secondary” winding.
* Designing your own transformer as per a specific application can be interesting, but not feasible without calculating the various parameters typically involved with them. The following discussion will take you through a few important steps and formulas and explain how to make a transformer.



**AUTOTRANSFORMER:**

An **autotransformer** is an electrical transformer with only one winding. The "auto" (Greek for "self") prefix refers to the single coil acting alone, not to any kind of automatic mechanism. In an autotransformer, portions of the same winding act as both the primary winding and secondary winding sides of the transformer. In contrast, an ordinary transformer has separate primary and secondary windings which have no metallic conducting path between them.

The autotransformer winding has at least three taps where electrical connections are made. Since part of the winding does "double duty", autotransformers have the advantages of often being smaller, lighter, and cheaper than typical dual-winding transformers, but the disadvantage of not providing electrical isolation between primary and secondary circuits. Other advantages of autotransformers include lower leakage reactance, lower losses, lower excitation current, and increased VA rating for a given size and mass.

EXAMPLE:

An example of an application of an autotransformer is one style of traveler's voltage converter that allows 230-volt devices to be used on 120 volt supply circuits, or the reverse. An autotransformer with multiple taps may be applied to adjust the voltage at the end of a long distribution circuit to correct for excess voltage drop; when automatically controlled, this is one example of a voltage regulator.



**OBJECTIVE:**

* To construct a1:1 transformer.
* To study the construction and working of autotransformer
* Learn how to design an electrical apparatus which convert alternating current from one voltage to another.
* Learn primary **purpose of an autotransformer** is to regulate the voltage of transmission lines and can be used to transform voltages.

**APPLICATION:**

* The main **application of Transformer** is to Step up (Increase) or Step down (Decrease) the level of Voltage. In other words, Increase or decries the level of Current, while Power must be same.
* The **autotransformer** has many uses and **applications** including the starting of induction motors, used to regulate the voltage of transmission lines.
* The autotransformer can be used to transform voltages when the primary to secondary ratio is close to unity.

**PROCEDURE:**

**a) Transformer**

* Calculate the number of turns for primary using the following formula and note down in Table – I

***PrimaryNumberOfTurns= TPV \* PrimaryVoltage***

* Calculate the number of turns for secondary using the following formula and note down in Table – I. Where TPV stands for Turns per Volt (Available wire in lab has 7.5 turns/V) Secondary Number of Turns = TPV × secondary voltage
* Make counter of winding machine to 0.
* Take a bobbin of 1” \* 1” (as shown in Figure2.2). At point 1 wrap insulating paper, take one end of primary winding out from point 2, mount the bobbin on winding machine then start winding copper wire around the bobbin. Until the desired number of turns for primary are completed. Cut the wire and take it out from point 3.
* 
* Wrap insulating paper on primary turns.
* Take out one end of secondary from point 4 and start winding copper wire around the bobbin until the desired number of turns for secondary is completed. Cut the copper wire and take out other end of secondary from point 5.
* The next step is assembling the core. Start inserting E laminations from alternating sides. After all E's have been inserted, the I's are slid into the voids. Align laminations with each other, and specially, align the screw holes of all the laminations.
* Using nut and bolt tight the laminations. At this point, the transformer is truly ready for trying.

**b) Autotransformer**

* Calculate the number of turns using the formula: ***Total Number of Turns= TPV × Total Volts***
* Make counter of winding machine to 0. Where TPV stands for Turns per (Available wire in lab has 7.5 turns/V)
* Take a bobbin of 1’’ \* 1” (as shown in Figure 2.2) at point 1 wrap insulating paper, take one end of winding out from point 2, mount the bobbin on winding machine then start winding copper wire around the bobbin. For creating taps of an autotransformer take out the copper wire of desirable length (don’t cut the copper wire) and after it again start winding until the desired number of turns are completed. Cut the wire and take it out from point 3.
* Wrap insulating paper on windings.
* The next step is assembling the core. Start inserting E laminations from alternating sides. After all E's have been inserted, the I's are slid into the voids. Align laminations with each other, and specially, align the screw holes of all the laminations.
* Using nut and bolt tight the laminations. At this point, the transformer is truly ready for trying.

**ISSUE:**

The given experiment was stress-free and numerical was calculated straightforwardly.

**CONCLUSION:**

WE **CONCLUDE** THAT **AUTOTRANSFORMER** HAVE LESS AMOUNT OF CU. LOSS REQUIRED. HIGH EFFICIENCY, POSSIBLE TO GET SMOOTH AND CONTINUOES VARIATION VOLTAGE.

Similarly, **for transformer**, the method could possibly use for the transfer of electricity across the country via the power lines. The circuit was not supplying the most efficient or maximum efficiency, due to the core losses not equaling the copper losses. So if you increases the voltage out, then the current out must decreases.

**POST LAB QUESTIONS**

* **What is the effect of frequency on mutual induction of Transformer?**

The EMF of a transformer at a given flux increases with frequency. Through operating at higher frequencies, transformers can be physically more compact because a given core is able to transfer more power without reaching saturation and fewer turns are needed to achieve the same impedance. However, properties such as core loss and conductor skin effect also increase with frequency.

Operation of a transformer at its designed voltage but at a higher frequency than intended will lead to reduced magnetizing current. At a lower frequency, the magnetizing current will increase. Operation of a large transformer at other than its design frequency may require assessment of voltages, losses, and cooling to establish if safe operation is practical. Transformers may require protective relays to protect the transformer from overvoltage at higher than rated frequency.

At much higher frequencies the transformer core size required drops dramatically: a physically small transformer can handle power levels that would require a massive iron core at mains frequency. The development of switching power semiconductor devices made switch-mode power supplies viable, to generate a high frequency, then change the voltage level with a small transformer.

Large power transformers are vulnerable to insulation failure due to transient voltages with high-frequency components, such as caused in switching or by lightning.

**2. What is an autotransformer?**

“An **autotransformer** is a transformer that uses a common winding for both the primary and secondary windings.”

**Working principle of autotransformer:**

**Autotransformer** is a single winding **transformer** that **works** on the **principle** of Faraday's Law of electromagnetic induction. Mostly used in low voltage range, for industrial, commercial and laboratory purposes. Also known as variac, dimmer stat, etc. **autotransformer** can be single and three-phase.

**Function of an autotransformer:**

An **autotransformer** is used mainly for the adjustments of line voltages to either change its value or to keep it constant. If the voltage adjustment is by a small amount, either up or down, then the transformer ratio is small as VP and VS are nearly equal.

**APPLICATION:**

* The **autotransformer** has many uses and **applications** including the starting of induction motors, used to regulate the voltage of transmission lines.
* The autotransformer can be used to transform voltages when the primary to secondary ratio is close to unity.



**3. What are the advantages and disadvantages of an autotransformer?**

**Advantages of an Autotransformer**

* Cheaper
* More efficient, because losses stay the same while the rating goes up compared to a conventional transformer
* Lower exciting current
* Better voltage regulation

**Disadvantages of an Autotransformer**

Some of the disadvantages of an autotransformer are:

* Larger short-circuit current
* No isolation exists between the primary and secondary windings
* Only useful for moderately smaller voltage changes