

# **JIGNASA STUDENT STUDY PROJECT**

**Title: TRANSFORMERS AND APPLICATIONS**

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*Under the*

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**DECLARATION**

Wedo hereby declare that the work presented in this study project entitled “**TRANSFORMERS AND APPLICATIONS**” is an original one and has been carried out by us in the Department of Physics G D C Peddapalli, Dist: Peddapalli and has not been submitted either in part or in full for the award of any Degree or Diploma of any University earlier.

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**CERTIFICATE**

This is to certify that the JIGNASA-Students' Study Project entitled "**TRANSFORMERS AND APPLICATIONS**" is an original one and has been carried out by **A.RISHITHA**- BSC MPCs II YEAR, **AZHAR KHAN**- BSC MPCs II YEAR, **T.SAI KUMAR**- BSC MPCs II YEAR, **V. SAI SANEETH** BSC MPCs II YEAR and **A.MEENAKSHI KUMARI** BSC I YEAR in the Department of PHYSICS, GOVERNMENT DEGREE COLLEGE, PEDDAPALLI Dist.: PEDDAPALLI, Telangana and completed under my supervision. It is a bona fide work done by them and has not been submitted elsewhere for the award of any Degree or Diploma or Competition. This study project is of the standard expected and I strongly recommend that it may be sent for evaluation.

Date: 15-12-2022

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## **ABSTRACT:**

This project highlights about the different types of Transformers and its applications.

The transformers used in household purposes, small industries heavy duty transformers are identified and learnt their applications.

The topic has relevance in day-to-day life as transformers are indispensable tools without which power circuitry becomes in effective. The involvement of the individuals of the groups for collection understanding the technical know-how is beyond the limitations of the group.

## **INTRODUCTION:**

In this project, we will learn what is a transformer? What are the different types of Transformers?

### **What is a Transformer?**

A transformer is a device used in power transmission to transfer electrical energy from one electrical circuit to another, or in multiple circuits at a time. In other words, it is a voltage control device that is widely used in the distribution and transmission of AC power.

These are made to increase or decrease the AC voltage between the circuits while controlling the frequency of the current by creating a conductive connection between the two circuits.

This is done through the application of Faraday's law of induction which states that "the magnitude of the induced voltage in a coil is proportional to the rate of change of the magnetic flux which cuts across the coil".

Transformers can also be used for isolation, where voltage is equal to the voltage output, with the individual coils not electrically tied to each other. A wide range of transformer designs and sizes are located in electronic and electric power applications.

## **TYPES OF TRANSFORMERS**

Following are the different types of transformers:

17. Step down transformer
18. Step up transformer
19. Single phase transformer
20. Three phase transformer
21. Power transformer
22. Distribution transformer
23. Current transformer
24. Isolation transformer
25. Potential transformer
26. Instrument transformer
27. Air Core transformer
28. Iron core transformer
29. Ferrite core transformer
30. Toroidal core transformer
31. Autotransformer
32. Grounding or earthing transformer



## 1 STEP DOWN TRANSFORMER



A step down transformer converts high voltage from the primary side to low voltage on the secondary coil resulting in a decrease in the output voltage. In this, the overall winding ratio of primary and secondary is always more than 1.

This means that the primary side has more windings as compared to the secondary side. In case a single-phase power outlet voltage is converted to a desired low voltage level, a step-down transformer is required. Generally, step down transformers are used in power distribution systems.

### **Applications of Step Down Transformer**

The applications of Step Down Transformer is varied but the main applications of Step Down Transformers are as follows:

- It is used in the main adapters and chargers for cell phones, CD players and stereos
- It can be used to step down the voltage level in transmission line
- In welding machines it is used in reducing voltage and increasing current.
- And it is to be used in televisions, inverters, voltage stabilizers etc

## 2 STEP UP TRANSFORMER



These types of transformers work almost the same as step down transformers. A step up transformer can convert low voltage from the primary side of the transformer to high voltage on the secondary side of the transformer.

In this, the ratio of the primary winding to secondary winding is less than 1 because the number of turns on the secondary is always greater than the number of turns on the primary. These devices have no internal moving parts and work on the principle of magnetic induction. A step-up transformer is mainly used in electrical power distribution.

### **Applications of the Step-up transformer**

The use of Step-up Transformers includes the following.

- These transformers are used in electronic equipment such as Inverters & Voltage Stabilizers for low to high voltage stability.
- It is used to distribute electrical energy.
- This transformer is used to change the high voltage in power transmission lines generated by generators.

- This transformer is also used to make electric motors running, X-ray machines, microwave ovens, etc.
- It is used to enhance electrical and electronic equipment.

### 3 SINGLE PHASE TRANSFORMER



A single-phase transformer is a type of power transformer that uses single-phase alternating current, which means it relies on a voltage cycle that operates in an integrated time phase. These are basically works based on the principle of Faraday's law of electromagnetic induction.

At constant variation of frequency and voltage level, the transformer transfers AC power from one circuit to another. It has two types of windings, the primary winding to which the AC supply is given and the secondary winding to which the load is connected. These are used for domestic inverters and for power supply in non-urban areas.

#### **Applications of a single-phase transformer**

The single-phase transformer is mainly used in low voltage appliances like home devices. Some of the applications of a single-phase transformer are:

- Decrease voltage in localized power distribution
- Regulation of voltage in television sets
- Used in lighting and heating devices
- Used in areas where the demand for electricity is low, such as rural areas
- Increasing voltage in home inverters

## 4 THREE PHASE TRANSFORMER



These transformers are used to convert the voltage of electronic systems with three-phase. They are available in various configurations, such as star-star, delta-delta, star-delta, and delta-star. Three-phase transformers are used to generate electricity and distribute it according to the power usage.

It is a transformer composed of three sets of primary and secondary windings, each set wound around an iron core assembly. Since they have three sets of windings, the primary and secondary windings will be combined to form a complete unit in either a star or delta configuration.

### **Applications of three-phase transformers**

Three-phase transformers are versatile machines that find their use in many fields. Some of the more common applications include:

- Power generation and transmission processes utilize three-phase transformers.
- Three-phase transformers can step up/step down voltages in many industries. These transformers are widely used in mining, printing, textile working, elevator, industrial automation, and petrochemical fields, among several others.
- As the three-phase transformer can exempt noise and high-frequency pulse interference from its internal coupling, they are essential when making precision machine tools. Present in high power industrial load systems, such as motor drives and rectifiers, among other equipment.

## 5. POWER TRANSFORMER



A power transformer is used to convert power from one circuit to another without changing its frequency. They are usually large in size and do not have any rotating or moving parts. The transformer works on the principle of mutual induction and requires an AC supply. Power transformer ratings are as follows 400kv, 200kv, 110kv, 66kv, 33kv.

It changes the voltage for the current in a circuit, while not impacting the total electrical power. So it takes high-voltage electricity with a small current and converts it into low-voltage electricity with a large current. Power transformers are seen in the public electricity grids and are generally used for the purpose of transmission of heavy loads.

### **Applications of Power Transformer**

- Power transformers used in electric power generation and distribution
- Used for reducing power losses during electric power transmission
- They are preferred in cases where the load is required to run at full capacity 24x7.
- It is used in high voltage step-up and step-down.

## 6. DISTRIBUTION TRANSFORMER



The distribution transformer provides the last or final voltage change in the power distribution system. Distribution transformers are like step down transformers, which convert high grid voltage into the voltage required by the end customer.

These transformers have low ratings such as 11 kV, 6.6 kV, 3.3 kV, 440 V, and 230 V. They are small as well as large in size and have a rating of less than 200 MVA. Distribution transformers are typically located at a service drop, where wires run from a utility pole to the customer's premises.

### **Applications of Distribution Transformer**

- This transformer changes from high voltage electricity to low voltage electricity, used in homes & businesses.
- The main function of this is to step down the voltage to provide isolation between two windings like primary & secondary
- This transformer distributes the power to remote areas which are generated from the power plants
- Generally, this transformer distributes the electrical energy to industries with less voltage under 33KV and 440volts to 220volts for domestic purposes.

## 7. MEASUREMENT OR INSTRUMENT TRANSFORMER



These are high accuracy class devices used to change the voltage or current levels. These transformers are used to measure electrical quantities like current, voltage, power, frequency, and power factor. The instrument transformer has a relay to protect the power system.

In this, the primary winding is connected to the high voltage or current circuit and the relay is connected to the secondary circuit. These are medium in size and are used for 5A current and 100 to 200 V.

### **Applications of Instrument Transformers:**

- They are used to reduce high voltages to 120V or other lower levels so that they can be measured using a voltmeter or used in other control circuits.
- The most common usage of instrument transformers is to operate instruments or metering from high voltage or high current circuits, safely isolating secondary control circuitry from the high voltages or currents.
- These transformers are used to measure current, power, monitoring the operation of power grid & protective relay. These transformers are used to measure, operating protective relay & power source.

## 8 CURRENT TRANSFORMER



Current transformers are commonly used to reduce or multiply alternating current (AC). This transformer produces a current in its secondary winding while it is proportional to the current in its primary winding. In addition, they are also used to measure and protect electricity.

When the current is too high and is applied directly to the measuring device, the current transformer helps to convert the high current in the circuit to the required value. Current transformers are current-detecting units of power systems and are used in stations, electrical substations, and industrial production.

Current transformers are used for protection, measurement and control in high-voltage electrical substations and the electrical grid. Current transformers may be installed inside switchgear or in apparatus bushings, but very often free-standing outdoor current transformers are used.

Types of Current Transformer:-1 Indoor Current Transformer 2 Outdoor Current Transformers 3 Bushing Current Transformer 4 Bushing Current Transformer 5 Portable Current Transformers

### **Applications of Current Transformers**

- These transformers are used to measure electric power in powerhouses, industries, grid stations, control rooms in industries for metering & analyzing the flow of current in the circuit and also for protection purposes.



## 9. ISOLATION TRANSFORMER



This type of transformer is used to transfer electrical power from an alternating current while isolating the powered device for safety reasons. The isolation transformer can provide galvanic isolation which means that no conductive path exists between the source and the load.

They can operate as step-up transformers or step-down transformers and have a turn ratio of 1:1, which means that the primary and secondary voltage is equal. This isolation is used to protect against electric shock and to suppress electrical noise in sensitive equipment. These are used in computers, measuring devices, or power electronic devices.

### **Applications of isolation transformers**

- Because in every way, isolation transformers are protected by an electrostatic shield in between the windings, they are used to power sensitive equipment like computers, electronic devices, medical equipment, and laboratory gadgets.
- Isolation transformers are preferable used in radios as they help in radio frequency isolation from the antenna to how much radio transmitter is required to separate the substantial components.
- Isolation transformers are used in telephone lines to amplify the cyclical intervals that contain digital information by assisting DC power isolation.
- One special application is a pulse transformer that transmits rectangular pulse signals and provides electrical isolation, which is suitable in some computer network designs.

## 10. POTENTIAL TRANSFORMER



Potential transformers or voltage transformers are commonly used to reduce voltage levels. They cannot be used to supply natural power to a load and are used with voltmeters, watt-meters, frequency meters, circuit breakers tripping circuits, etc. In this, the primary winding is connected to the high voltage circuit and the secondary winding is connected to equipment or other circuits.

### Applications of a Potential Transformer

- Potential transformers are deployed in metering devices for measuring energy billing and other calculation purposes.
- It is used as a protection control device that can be of system protection or protective relaying purposes.
- It is used as a load survey tool for measuring industrial loads and its economic management.
- In power grid as a voltage synchronizing devices
- Used in metering and relay circuits.
- Uses in power line carrier communication networks.
- Used in protection devices electrically.
- Used for the protection of impedance in different applications like the generators.
- Used for protecting feeders.
- Used as protection voltage transformers.

## 11. AIR CORE TRANSFORMER



In this transformer, both the primary and secondary windings are set on a non-magnetic stripe. It has flux linkage in both the windings through the air. The mutual inductance in the air-core is low, which means the reluctance to be given to the generated flux is high in the air medium.

### **Applications of Air Core Transformers:**

- Used in smaller electronic devices which are based in antenna coils.
- Used in portable communication devices.
- Used in radio transmission systems.

## 12. IRON CORE TRANSFORMER



In this type, both the primary and secondary windings are set on multiple soft iron plates providing an ideal connection to the flux. Compared to the air core, it offers less reluctance to linkage flux due to the conductive and magnetic properties of iron.

Since they have a high magnetic permeability capability, they are used to limit and direct magnetic devices such as electric motors, generators, inductors, etc. Different types of core plates are available in the market depending on the core size and shape. These are the widely used types as well as they are heavy in weight and size.

### **Applications of Iron Core Transformers:**

- For transmitting low voltage of electricity from the primary to the secondary core
- For supplying accurate voltage.

### 13. FERRITE CORE TRANSFORMER



This type of transformer uses a magnetic core made of ferrite on which the windings of power transformers and other parts are made. Ferrite cores have high magnetic permeability, so they are used in high-frequency applications such as switch-mode power supplies.

The reason is that it provides low losses at high frequencies, so they are used extensively in the cores of RF transformers. Ferrite core transformers are also available in a variety of sizes, shapes depending on the requirement of the application.

#### **Applications of Ferrite Core Transformer**

- The ferrite core transformer is used as Converter and Inverter Transformers, Differential Mode Inductors, Power Transformers, Pulse Transformers, and Telecom Inductors.

## 14. TOROIDAL CORE TRANSFORMER



The toroidal core transformer uses a magnetic core which almost looks like a ring or donut called a toroid. They are passive electronic components, consisting of a circular ring-shaped magnetic core of ferromagnetic material around which the wire is wound.

Due to their built-in design, leakage inductance is very low and provides very high inductance. This transformer is used in a wide range of electronic circuits such as power supplies, inverters, and amplifiers.

### **Applications and uses of Toroidal Core Transformer:**

- To reduce the acoustic noise significantly
- To Obtain low power consumptions and power losses
- For getting lower stray magnetic field
- To enhance electrical efficiency

## 15. AUTO TRANSFORMER



These types of transformers use a common winding for both primary and secondary windings. The autotransformer winding has three taps where the electrical connections are made. Autotransformers have the advantage of being smaller, lighter, and cheaper than typical transformers.

But it also has the disadvantage that it cannot provide electrical isolation between the primary and secondary circuits. In addition, they offer lower leakage response, lower losses, lower excitation current, and increased VA ratings for a given size and mass.

### **Applications of Auto Transformers:**

- Used in both Synchronous motors and induction motors.
- Used in electrical apparatus testing labs since the voltage can be smoothly and continuously varied.
- They find application as boosters in AC feeders to increase the voltage levels.

## 16. GROUNDING OR EARTHING TRANSFORMER



It is an underground WYE or delta-connected system used to provide a ground path or neutral in a three-phase electric power system. This can help reduce the voltage transients when a ground fault happens.

These are part of an earthing system of a network, in that they allow a three-phase system to adjust phase-to-neutral loads by providing a return path for current to neutral. The grounding transformer usually includes a single winding transformer with a zigzag winding design.

### **Applications of Grounding Transformers:**

- To provide low-impedance path to ground.
- To limit transient over voltages.



## **CONCLUSION:**

This project has given scope to learn the variety of transformers available.

The knowledge of technical know-how and their applications have enriched the knowledge of students.

This project facilitated the students to know the uses of transformers from household to industry.