Project Report of Repairing and Modification of Power Suppy in Physics Lab

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Project report on

Repairing&

modification of power supply

Submitted to university pune

By

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Under Gaidance

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ACKNOWLEDGEMENT

It gives me a great pleasure on bringing out project entitled

Reparing and modification of pawer supply *Hgreatly accept this opportunity to convey my heartiest thanks and*

express my deep sense of gratitude to my guide for his invaluable guidance,.

kind co-operation, meticulous care with which they examined the right up

through the duration of work.

I wish to express my sincere thanks to our Head of Department

Sadekar H. K., Professors, Lecturers and non-icaching staff of Dept. of

Physics for their valuable suggestions.

I would like to say thanks to all my friends whose help aund criticism

made me uble to do betier of my project.

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(AFFILIATED TO UNIVERSITY OF PUNE)

CERTIFICATE

This is to certify that the project work entitled "repairing and modification of pawer suplly"

has been successfully carried out by mis **prachi sanjay kakade** during the year 2020-2021 as a rescarch project.

Sadekar.h.k

Head. Depatment of Physics

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Chapter:-1

Power Supply –

Power Supply is a component that supplies power to at least one electric load. Typically it converts one type of electrical power to another but it may also convert a different form of energy as solar, mechanical or chemical into electrical energy.

As a common part of all the electronic power supplies circuits, rectifier circuit provides DC power supply from available As Supply for proper function of electronic equipments. Rectifier is a circuit which converts an alternating voltage into direct voltage all the circuits are operated with diodes. The unidirectional conducting property of a diode finds great application in reclifiers. A forward biased PN-juction diode act as a closed switch since it allows the large current to lfow through it.Areverse biased PN- junction diode acts as an open switch, since it blocks the current.

The rectifier circuit can be implemented with different solid state electronic or electrical components like diodes ,scrs .MOSFETS and so on upon these components used rectifier operation is varied in order to get the required output before going to know its types let us known as" rectifier ".

A rectifier is a circuit that is used for converting Ac supply into unidirectional Dc supply this process of converting alternating current (AC) to direct Current (DC) is also called as rectification

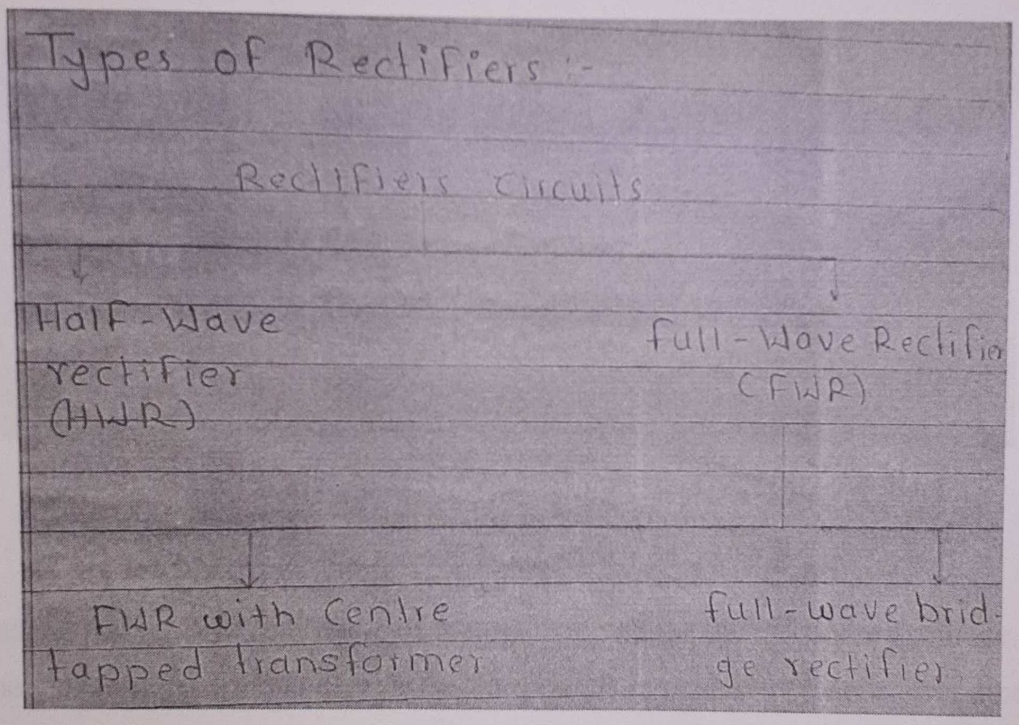
These bridge rectifiers are availabale in different packages as modules ranging from few amperes to several hundred amperes.Mostly in bridge rectifier Circuits, semiconductor diode is used for converting Ac since it allows the current flow in one difrection only

Chapter:-2

Rectifier:-

Bridge rectifier selection depends on load rewqure ments and apart from this some more conside ration are component ratings, breakdown voltage ,for ward current rating,transient current rating temperature ranges,mounting rewuirements ,etc we can connect the diodes in different configuration for obtaining different types of rectifiers

Type of Retifiers



There are two types of rectifire

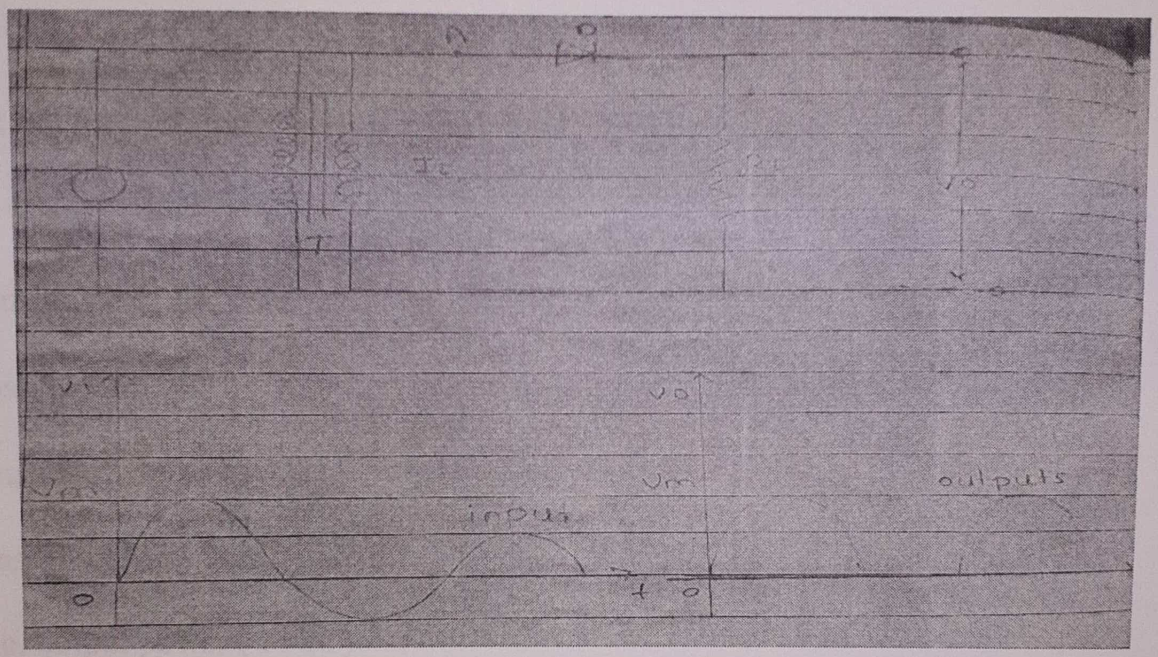
1. Half Wave rectifier
2. Full-Wave Rectifier

Rectifiers are classified into a variety of configurations as shown as shown in below figure Depends on factors like type of supply bridge configuration, control nature, componnts used, etc these rectifiers are

Classified .Majorly rectiFiers are classified into single phase and three phase rectifier and thes arefurther classified into uncontrolled,half controlled and full controlled rectifiers let us see in brief about some of these types of rectifiers

1) Half –Wave Rectifier (HWR)

The basic half-wave diode rectifier circuit alongwith input and output is shown in fig T is the step-sown transformer and R1 is the load resistance.



Working : -

During the positive half cycle of the input ac voltage ,the secondary voltage across the transformer VAB is positive I e A is positive and B is negative . There fore, diode D in in forward bias and starts conducting while conducting the fiode acts as short circuit & the current flows in the circuit from terminal A through RL to terminal B as shown is fig .Thus ,same output voltage is developed across RL similar to half cycle of ac input

During the negative in put lalf cycle,the secondary voltage across the transformer VAB is negative i.e A is negative with respect to B hence the diode D is reverse biased and offer a high resistance .Hence

we can replace it by an open circuited switch.There is no voltage drop across RL ie the loade voltage and load current both are zero.The variation of output voltage with input voltage is as shown in fig .The voltage,through not a perfect d.c , is at least unidirectional. This circuit

is called as half wave rectifier because it delivers power to the load during only lalf of the a.c supply voltage .

Analysis of Half - wave rectifier :-

1. Output d.c current or Average Valus of Current.

The Average value of a sine wave over one complete cycle is zero.

The average values of output current and output voltage in a half wae rectifier circult.

Il dc = Im

2. Out put d.c voltage or Average load voltage. Vl dc = Vm

Vl dc = Vm

3. Rms value of load current

I l rms = Im /2

4. Rms value of load voltage (Vlrms)

Vlrms = vm /2

5. D.c. output power (Pl dc)

Pl dc = V2 l dc (because Vm l = Vl dc

6. A c input power (pac)

Pac = I 2 m (RS+RF+RL)

7. Rectifier efficiency or power conversion efficiency Max = 4 2v

Disadvantages of half wave rectifier :-

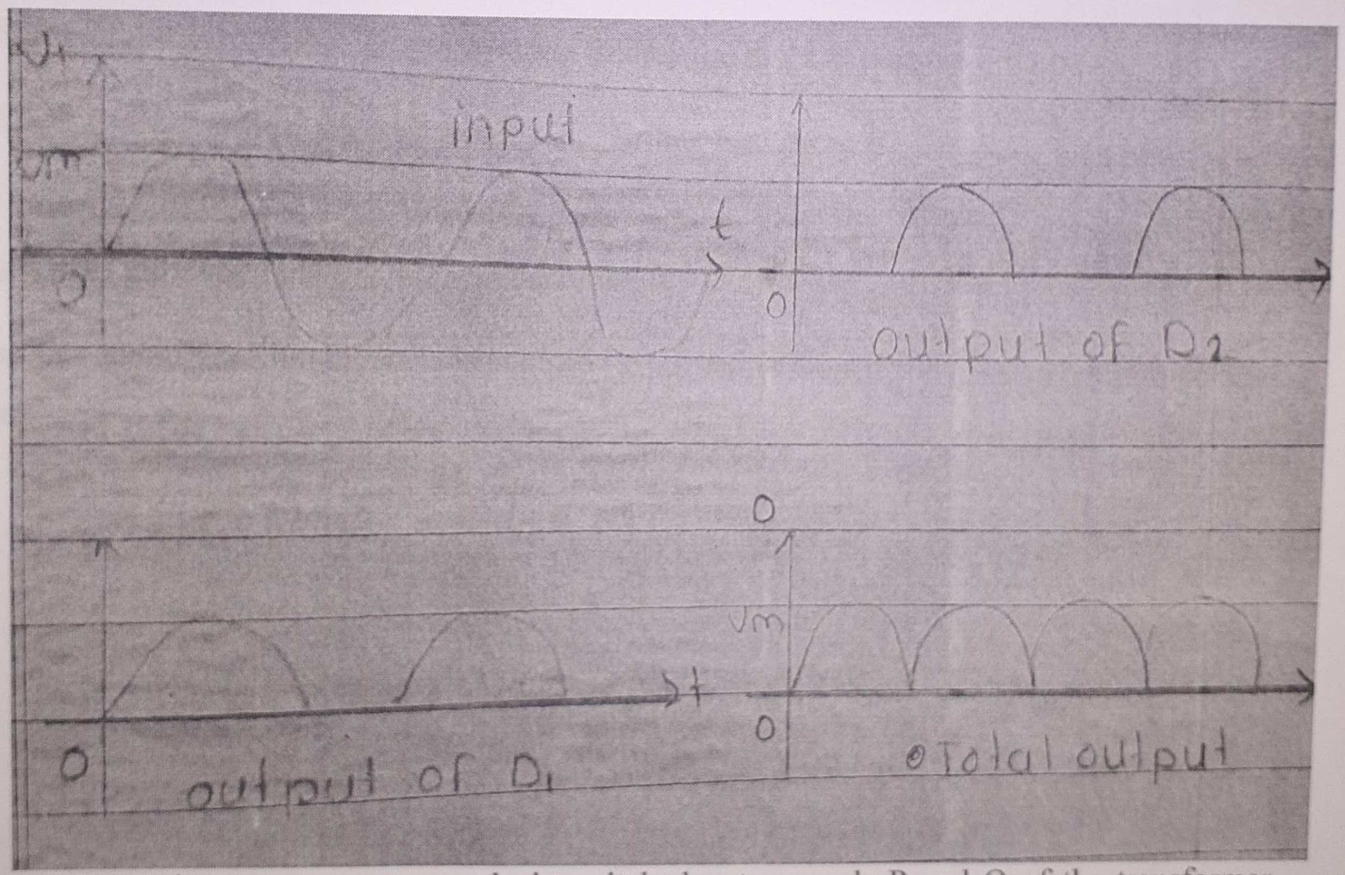
- Ripple factor is high (121%) - Rectification efficiency is low - Output D.C. voltage and current is low - Larger filter components are required while using half wave rectifier in power supply. v Full Wave Rectifier (FWR)

This type of rectifier uses two diodes and a transformer with center trapped secondary winding wuring the positive half cycle of the input AC diode Di is Forword hiased and the current starts flowing to the loade through it

During the negative half of the input diode D2 forward biase d and D1 becomes reverse biased load current start flowing through D2 during this negative peak note that the current flow through loade has not changed even when the voltage polarity chaged

Full wave rectifier.

In a Full wave rectifier,both half cycle of the input are utilized with the help of two diodes working alternately.The fullwave rectifier consists of two diodes and a centre tapped transformer.



When input a.c. power supply is switchedon two wnds P nad Q of the transformer secondary become + ve and – ve alternately

During positive half cycle of a.c. input,terminal p is positive,terminal G is at zero potential and terminal Q is negative During this diode D is forward biased & Conducts Current flows along PDCa BG As a result,voltage appedrs across Rl.

During negative half cycle the terminal Q becomes positive and diode O2 Conducts

The current flows along QD2CABG thus,we find that current keeps on Flowing Through R1 in the same firection form A to B in both half cycles of a.c input it means that both the half cycles of a.c. input are utilized as shown in fig Frequency of rectifier output is twice the frequency of supply.The input and output wave forms of centre tapped transformer are as shawn in above fig.

Advantages of FWR

1. low ripple factor as Compared with HWR

2. Better rectification efficiency

3. No possibility of transformer core saluration

Disadvantages of FWR

1. Since PIV = 2vm,size of diodes is larger & they are more expensive

2. Cost of centre tapped trans former is high. Bridge Rectifier : -

The disadvantages of the full wave rectifier such as high Piv and use of centre tap ped transformer are overcome in bridge rectifier circult

It requires four diodes,but the transformer used is not centre tapped and has a maximum voltage of vm

Chapter:- 3

Bridge rectifier:-

Working: -

During the positive half cycle of input,terminal p of secondary is positive and terminal Q is negative During this cycle, diodes D, and B3 become forword biased (on) whereas D2 and D4 are reverse biased Hence Current Flows along PED1 ABD3 DQ producing a drop across R1 During the negative half cycle of input,Secondary terminal Q becomes positive and p negative now D2 and D 4 are forward biased and D and D3 reverse biased Circuits current flows along QDD = ABD4EP as shown in fig we find that current keeps flowing through Rl in same direction AB during both cycles of the input point A of bridge rectifier always acts as anode & point C as cathode. The output voltage ccross Rl is as shown in fig Its frequency is twice that of supply feq

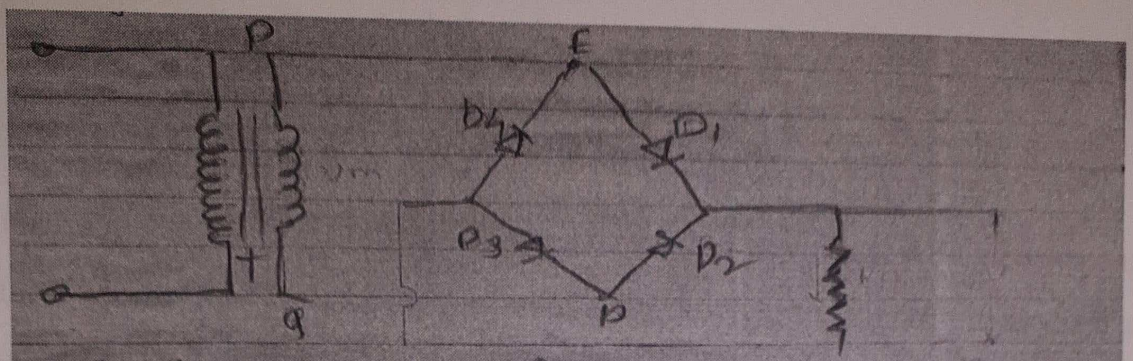
Advantages of bridge rectifier:-

Bridge rectifier requires small transformer instead of centre tapped used on full wave rectifier.This reduces cost of the bridge rectifier. This Circuit is most suitable for high voltage application. This is because the maximum negative voltage that apperars across each diode is vm Hence diodes with PIV rating of +vm are needed Core saturation does not take place Therefore,transformer losses are reduced core losses are avoided because wqual and opposite currents flow through the transformer in each cycle It has less PIV rating for diode.

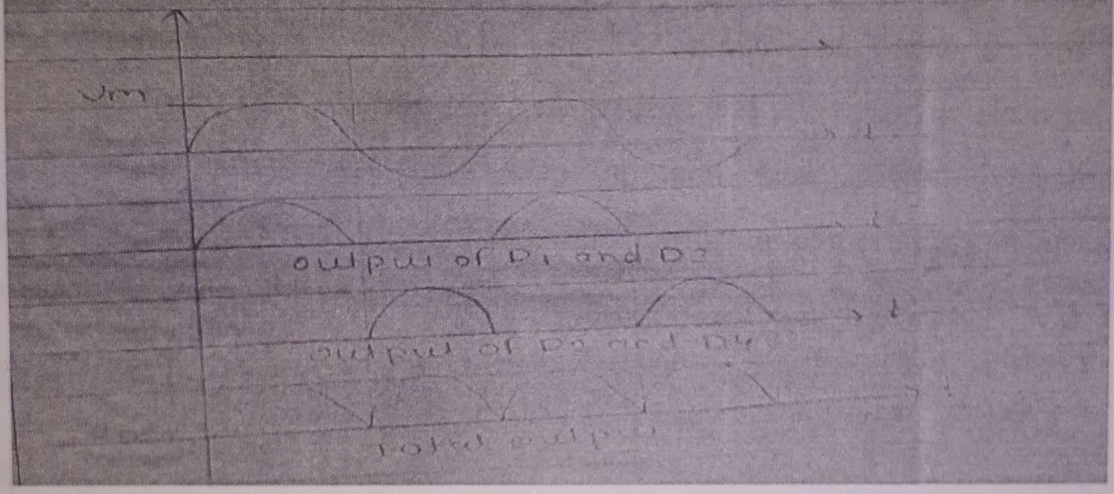
Disadvantagws of bridge rectifier: -

The number of diodes used are four instead of two for FWR as two diodes conduct simile timeously, the voltage drop increases and output voltage reduces.

Using the same secondary voltage, this bridge rectifier can produce almost double the output voltage as compared with full wave centre tapped trans former rectifier during the positive half of the input Ac diodes D1 and D 2 are forward biased and D 3 and D4 are reverse biased Thus load Current flows through D1 and D2 diodes During the negative half cycle of the input Diodes D3& D4 are forward biased and D1 & D 2 are reverse biased .Therfore load Curent flws through D3&D4 diodes



Bridge wave rectifier



Chapter:-4

Transformer:-

It is a device which converts input ac voltage into desired ac voltage it may be steps up in which the output of transtormer is more than input or steps down to the electronic devices and cirouits requiring a c power it also provide is lation from the supply line .

There are various types of transformer used in the electrical power system for diferent purposes,like generation,dislribution and transmission and utilization of electrical power.The different types of transformer are step up and step down. Transformr, power Transformer,distribution transformer,instrument transformer comprising current and potential transformer.single phase and three phase transformer Auto transformer,etc.

Types of Transformer : -

1. Step up and step down transform
2. Power Transformerr
3. Distrivution Transformer
4. Uses of Distribution Transformer
5. Instrument Transformer
6. Current Transforer
7. Potential Transformer
8. Single Phase Transformer
9. Three Phase Transformer

1. Step up and step down transformer : -

This type of transformer is categorized on the basis of a number of turns in the primary and secondary windings and the induced emf

Step up transformer trans forme a law voltage,high current ac into an high voltage low current AC system in this type of transformer the number of turns in the secondary winding is greater than the number of turns in the secondary winding is greater than the mumber of turns in the

primary winding if (V2>V1) the voltage is raised on the output side and is known as tep up transformer.

Step down transformer converts a high primary voltage associated with the low current into a low voltage high current with this type of transformer the number of turns in the primary winding is greatev than the number of turns in the secondary winding is greater than the number of turns in the secondary winding IF (V2<V1) the coltage level is lowerd on the output side and is known as tep down transformer.

2. Power transformer:-

The power transfromers are used in the transmission networks of higher voltages The ratings of the power transformer are as follows 400kv,200 kv,110 kv ,66 kv,33 kv They are mainly rated above 200 MVA mainly installed at the generating stations and transmission substations

They are designed for maximum efficiency of 100 %

They are larger in size as compared to distribution transformer.

At a very high voltage,the Power cannot be distributed to the consumer directly,so the power is steppd down to the desired level with the help of step down power transformer.

The transformer is not loaded fully hence the core loss takes place for the whole day,but the copper loss is based on the load cycle of the distribution network If the power transformer is connected in the transmission network,the load fluctuation will be very less as they are not connected at the consumer end directly but if connected to the distribution network there will be fluctuations in the load.The transformer is loaded for 24 hours at transmission station,thus the core and copper loss will occur for the whole day

The power transformer is cost effective when the power is generated at low voltage levels.

If the level of voltage is raised,then the current of the power transformer is reduced,resulting in I2R losses and the voltage regulation is also in creased.

3. Distribution Transformer :-

This type of transformer has lower rating like 11kv,6.6 kv , 3.3 kv ,440 v & 230 V They are raled less than 200 MVA and used in the distribution network to provide voltage trans formation in the power by stepping down the voltage level where the electrical energy is

distributed and utilized as the consumer end the primary coil of the distribution transformer is wound by enamel coated copperor aluminum wire.

A thick ribbon of aluminium and copper is used to make secondary of the trans former which is high current law voltage winding

Resion impreg nated paper and oil is used for the insulation purpose

The oil in the transformer is used for v Cooling v Insulating the windings v Protecting from the moisture

Types of distribution

1. Mounting location

2. Type of insulation 3. Nature of supply

The distribution transformer less than 33 kv is used in industries and 440,220 V is used for the domestic purpose

It is smaller in size,easy to install and haslow magnetic losses and is not always loaded fully.

As it does not work for constant load through out 24 hours as in the daytime its load is at its peak and during the nighl hours it is very lightly loaded thus the efficiency depends on load cycle and is calculated as all day efficiency . The distribution transformers are designed for maximum efficiency of 60 to 70 %

4. Uses of Distribution Transformer : -

Used in pumping stations where the voltage level is below 33 KV

Power supply for the overhead wires railways electrified with AC

In urban areas,many houses are feb with single phase distribution transformer and in rural areas,it may be possible that one house rewuires one single transformer depending upon the loads.

Multiple distribution transformers are used for Industrial and commercial are as used in wind farms where the electrical energy is generated by the wind mills There it is ued as a power collector to

connect the substations which are away from the wind energy generation system.

5. Instrument Transformer : -

They are generally known as an isolation transformer.

Instrument transformer is an electrical device used to transformer current as well as voltage level.

The most common use of instrument transformer is so safely isolate the secondary winding when the primary has high voltage and high current supply so that the meavsring instrument,energy meters or relys which are connected to the secondary side of the transformer will not get damaged the instrument transformer is further divided into two types

Current transformer (CT)

Potential transformer (PT)

6. Current transformer : -

The current transformer is usedfor measuring and also for the protection when the current is the circuit is high to apply directly to the measuring instrument,the current transformer is used to transform the high current into the desired value of the current required in the circuit.

The primary winding of the current transformer is connected in series to the main supply and the various measuring instruments like ammeter,voltmeter,wattmeter or protective relay coil.They have accurate,current ratio and phse relation to enable the meter accuralely on the secondary side The term ratio has a graet significance in CT.

For example; if its ratio is 2000:5 ,it means a CT has an output of 5 Ampere when the input current it 2000 amp on the primory side.The accuracy of the current transformer depends upon many factors like Burden.load,temperature,phase change,rating,saturation etc. in the current transformer,the total primary current is the vector sum of the excition current and the current equal to the reversal of secondary current multiplied by turn ratio ehere,

Ip – Primary Current

IS – Secondary or seversal Current

Io- excitation Current

KT- turn ratio

7. Polential Transformer : -

The Potential transformer is also called as the voltage transformer the primary winding is connected across the high voltage line whose voltage is to measured,and all the measuring isstruments and meters

are connected to the secondary side of the transformer .The main function of the polential transformer is to step down the voltage level to a safe limit or value.The primary winding of the potential transformer is earthed or grounded as a safely point for example : the voltage ratio primary to secondary is given as 500;120 , it means the output voltage is of 120 V ehen the 500 V is applied to the primary .The different types of potential transformer are shown below in the figure

8. single Phase transformer

It is a static device,works on the principle of faraday's law of mutual induction at a constant level of frewuency and variation of voltage level,the transformer transfers AC Power from one circuit to the other circuit There are two types of windings in the transformer.The winding to which AC supply is given is termed as primary winding and in the secondary winding the load is connected.

9. Three Phase Transformer : -

If the three single phase transformer is taken and connected together with their all the three primary winding connected to each other as one and all three second are windings to each other,forming

Aas one secondary winding,the transformer is saide to behave as three phade transformer,that means a bank of three single phase transformer connected together which act as a three phase transformer Three phase supply is mainly used for electric power generation,transmission and distribution for industrial pureopse it is less costly to assemble three single phase transformer to form three phase transformer than to purchase one single three phase transformer the three phase transformer connection can bedone by star (Wye) and delta (Mesh) type

Chapter:- 5

Rc Filter Circuit: -

We have seen that output of various rectifier circuits is pulsating it has d.c. value and some a.c. variation called sipple such output is not suited for driveng sophisticated ecectronic devices. Acircuits that coverts a pulsating output from a rectifier into a very steady d.c. level is called as filter.

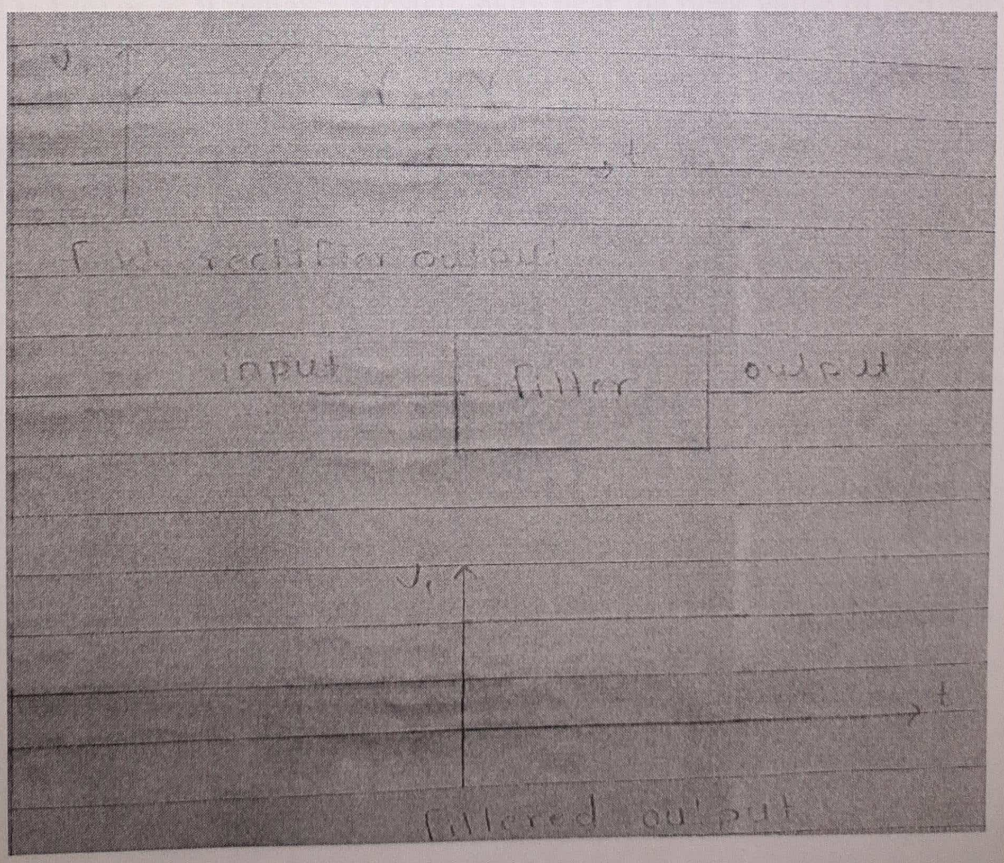
The process of removing or minimizing the ripples in the rectifier output is known as filiering.

Depending upon components used and their configuration ,the filers are classified into following steps.

1. Capacitor input filter

2.Choke input filer

3.LC filter



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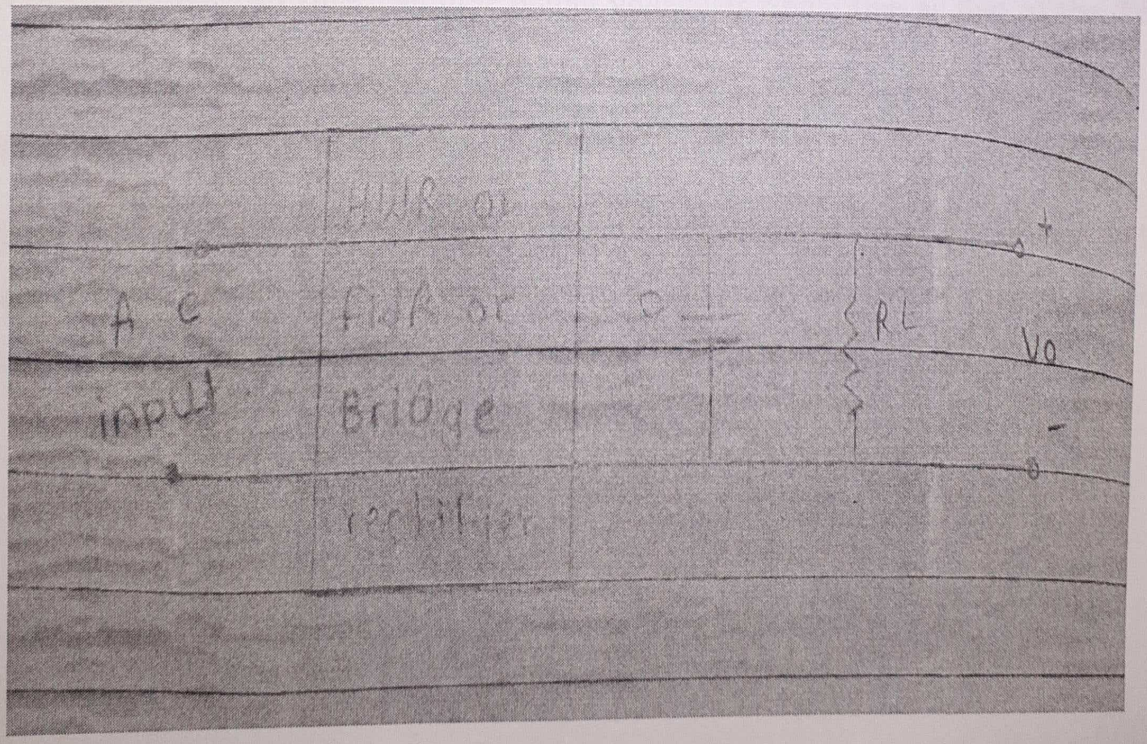
Capacitor filter:

Capacitro filtrs is used to reduce the ripple content in the output of a rectifier to obtain pure d.c. voltage A rectifier along with capacitor input filters is shown in fig cis the filter capacitor which is connected across load resistance RL. The value of c is very large in order to reduce the ripple electrolytic capacitors are used for this pureose.

The pulsating direct voltage of the rectifier output is applied across the capacitor .As rectifier voltage increases,it charges the capacitor and also supplies Current to load.

At the end of wuarter cycle the capacitor is charged to pedk value of rectifier voltage (VM) Now rectifier voltage starts decr During this capaciror discharges through the load RL and voltage across the parallel combination of campacitor and load resistance decr as shown by line AB in fig But the voltage across the load decr slightly because immediately the next voltage peak occurs and recharges the capacitor again.The process in repeated again and again.The resulting output wave form is ABCDEFG it should be noted that very small ripple is left in the output .The output is higher as it remains substationally near the peak value of rectifier output voltage



The ripple factor for capacitor filter with FWR or bridge rectifier is where F is frequency of a.c. C is capacitance and RL is the load resistance For frequency of 50 HZ, V = 2890 CRL.

When the value of Rl is very large,a filter capacitor takes for charging the diodes will conduct during the time BC and discharge for longer time

Therefore,diode current flows in the from of pulses of very short duration of time like AB and CD ,etc. During these intervals, the diode output voltage is greater than capacitor voltage which is also load voltage Hence diode current is surging current is takes the form of short duration pulses A small resistance is connected in series with the diode to limit the surge current when the diodes is reverse biased,the voltage across it is the sum of capacitor voltage and secondary voltage VM hence PIV for capacitor filter is P1V+2Vm

The capacitor filter is most popular because of its low cost ,small size little weight and good char for small loade currents this type of filter is preferred it is commonly used in transistor radio battery eliminator

It has following disadvantages like

1. Dependence of ripple factor on RL

2. Relatively poor regulation. v Filter : -

The main task of filter is to remove the fluctuations present in the output voltage supplied by rectifier practically, no filter can give output voltage as ripple free as that of the d.c. battery .But filter gives output close to d.c. power supply.

A capacitor filter is most common

We have seen that in this power supply output voltage change with the variation in the input voltage or load in many electronic applications, it is required that output voltage should remain constant irrespective of the variations in the input voltage or load.

Result and conclusion

1. The project work of power supply in physics lab is successfully repaired and modified.
2. In this power supply we gate Variable DC 0 - 30 volt.
3. AC voltage measurements are done between negative potential and positive potential.
4. This power supply is very useful in physics lab to do the various experiments in electronics which needs DC voltage.
5. We gate DC voltage which ranges from 0.5 V, 1 V, 1.5 V, 2 V, 2.5 V, 3 V....30 V.

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