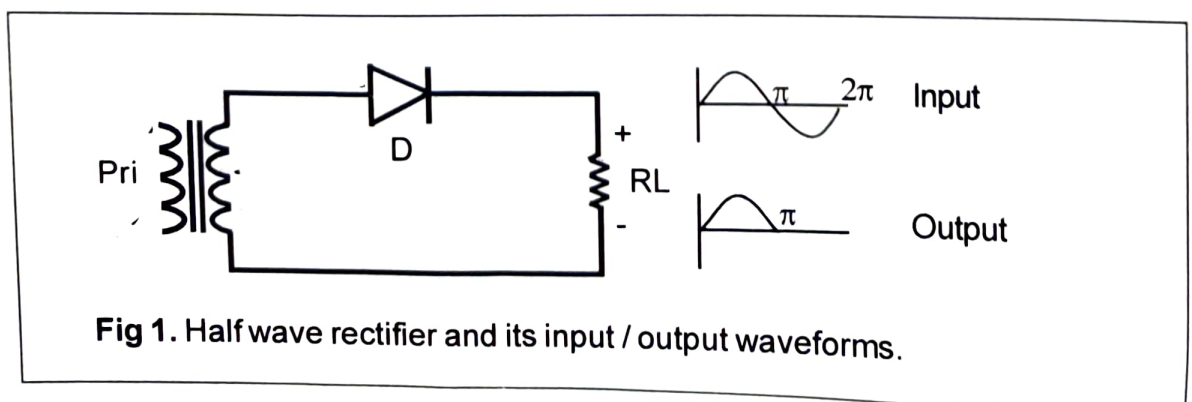


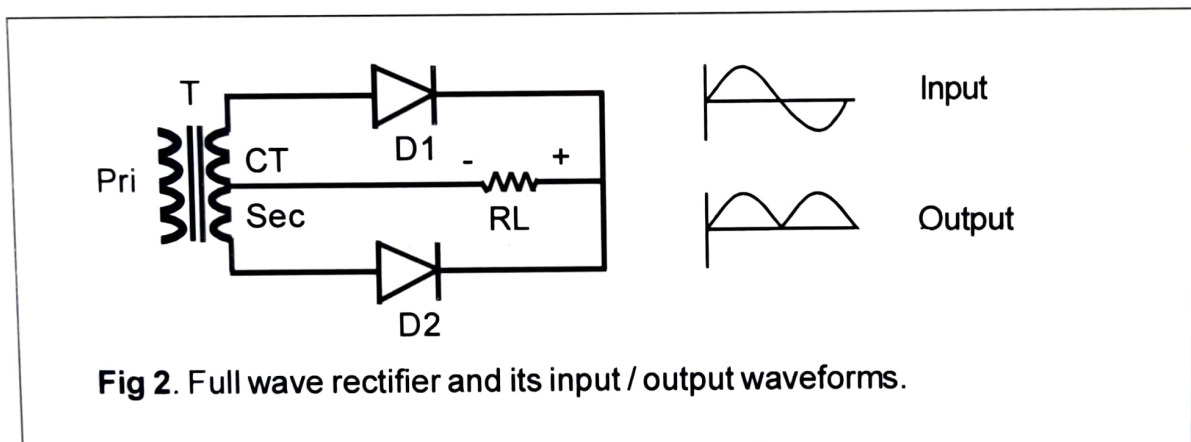
DIODE RECTIFIER & FILTER CHARACTERISTICS

This board is designed to study of diode as half wave/ full wave/bridge rectifier and filter circuits. The board contains, step down transformer having centre tap, four silicone rectifier diodes, one inductor, two capacitors, fixed RL and 3 meters from which one is dual range high impedance ac meter.

Half wave rectifier : A diode is device which conducts in one direction only. It conducts only when its anode is more positive than its cathode. In a half wave rectifier circuit the diode conducts during positive half cycles only. The current passes through the load RL and a directional voltage developed across it. During negative half cycle of the input it stops conducting and voltage across the load resistance during this period is zero. In this way a unidirectional voltage (signal) achieved from an alternating voltage (signal). The magnitude of this unidirectional voltage is called V_{dc} and its theoretical value equal to, V_m / π . As stated earlier that these dc voltages are half wave rectified which develop and decay alternately in each cycle. Thus an ac voltage is imposed which is called as ripple voltage. In a half wave rectifier its ratio is about 1.2, between ac voltage and dc voltage at output.



Full wave rectifier : In a full wave rectifier circuit there are two diodes and a transformer with centre tap in its secondary. It provide out of phase voltage to both diodes. Thus each diode conducts successively on its turn in each half cycle. As both diodes has same configuration thus an directional voltage devloped across R_L , which is equal to $2V_m / \pi$. The $2V_m$ is taken since both half of input cycle is converted into dc. There is still load current falls to zero when the cycle crossover. Thus a ripple voltage generated at output, which has magnitude equal to 0.48 approx, between ac and dc voltages at output.

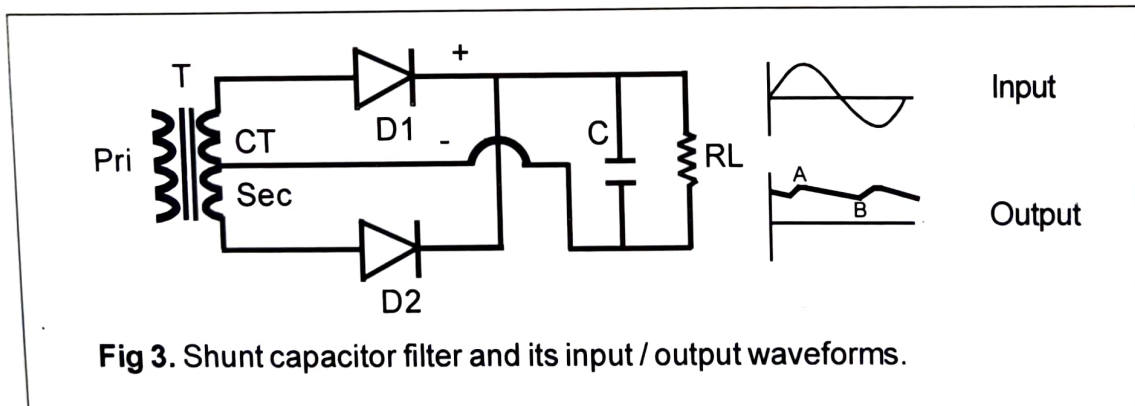


Full wave bridge rectifier : In a full wave bridge rectifier circuit there are four diodes and a transformer with its single secondary. A pair of diode conducts successively on its turn in each half cycle producing +ve and -ve dc. As both pair of diodes has same configuration thus an directional voltage devloped across R_L , which is equal to $(2V_m / \pi) - V_d$. The $2V_m$ is taken since both half of input cycle is converted into dc, and $V_d (= 0.6V)$ is taken because there is one more diode in circuit. There is still load current falls to

zero when the cycle crossover. Thus a ripple voltage generated at output, which has magnitude equal to 0.48 approx, between ac and dc voltages at output.

Rectifier with C filter : Also called shunt capacitor filter filter circuit. As shown below an electrolytic capacitor is connected across the output of rectifier circuit. The capacitance offers a low reactance to the ripple current of ac component (at 100Hz in shown fig). Since the R_L is $>$ than the capacitive reactance (X_C) a small ripple current flows in load. The capacitor charges to peak value of $dc = V_m$, and then discharges through load. The slope shown AB depends upon X_C of C and value of R_L .

Note : The X_C is greater at half wave configuration since ripple freq is 50Hz.



Rectifier with L filter : Also called series inductor filter filter circuit. As shown in fig 4, an inductor is connected between the output of rectifier and load circuit. The inductance offers a high reactance to the ripple current of ac component. Since the R_L is $>$ than the dc resistance of L, a small loss of dc voltage obtained across load. The inductive reactance (X_L) of L increase with the frequency better filtration obtained at higher harmonic frequency

(in half wave rectifier it is 50 Hz and in full wave it is 100 Hz). The output voltage thus have ripple current of low amplitude of relative frequency. For dc the dc resistance of L is low thus $V_L = V_{dc} (R_L / (R_{choke} + R_L))$. The $V_{r\ load} = V_r (R_L / X_L + R_L)$.

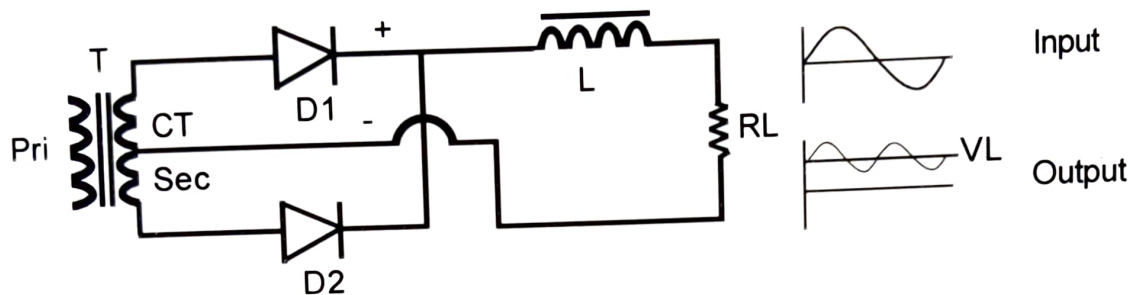


Fig 4. Series inductor filter and its input / output waveforms.

Rectifier with L-C filter : Also called series inductor shunt capacitor filter circuit. As shown in fig 5, an inductor is connected between the output of rectifier and load circuit, with a shunt capacitor across the load. The inductance offers a high reactance to the ripple current of ac component, while capacitor offers a low reactance to the ripple. Since the R_L is \gg than the dc resistance of L, a small loss of dc voltage obtained across load. As the circuit is similar to series inductor filter with a difference is added C. The ripple across the load is now $V_{r\ load} = V_r L (X_C / X_L)$, where $V_r L$ is the ripple voltage as before in fig 4 circuit.

Note : In half wave configuration the V_r are greater since the ripple frequency is low i.e. 50 Hz, rather than 100 Hz in full wave.

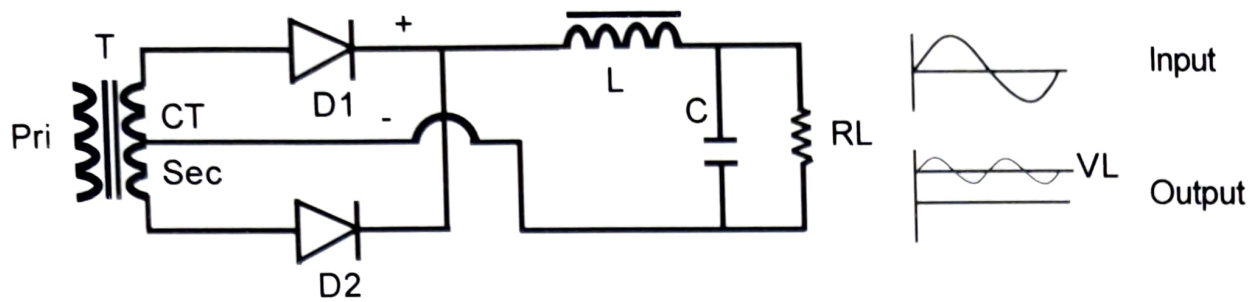


Fig 5. L - C filter and its input / output waveforms.

Rectifier with Pye filter : It is same as L - C filter, where another capacitor added in the circuit connected across the rectifier output. It is the most efficient filter circuit, since double the capacitor brings XC lower and a better filtration offered by it.

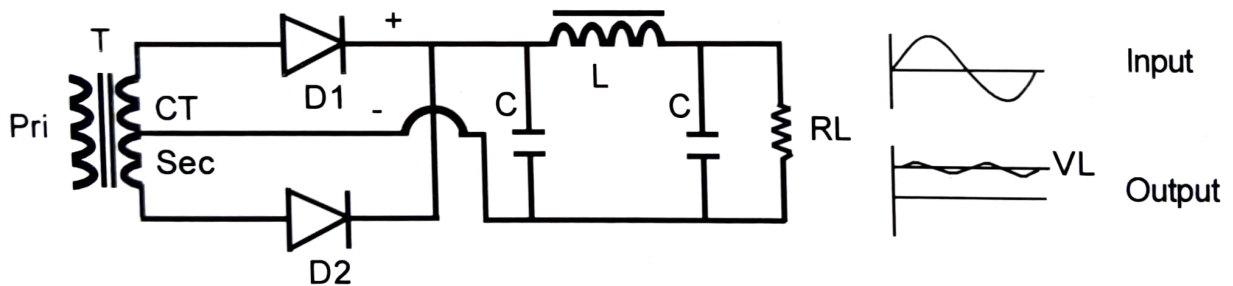


Fig 6. PYE (II) filter and its input / output waveforms.

Experiment procedure

a. To study half wave rectifier circuit.

1. Connect the circuit as shown in fig 7. It becomes a half wave rectifier circuit since only diode D1 is in circuit, note L is short circuited and C open.
2. Switch on the power. Adjust RL for 50mA load current.
3. Measure AC across the transformer secondary.

4. Note the reading of dc voltage from fitted meter as V_{dc} . Calculate the theoretical value and compare it with found value, where theoretical value,

$$V_{dc} = \{V_{AC} (rms) \times \sqrt{2} / \pi\}.$$

5. Connect the AC voltmeter at the dc output socket fitted at +ve of RL side.

Note the AC ripple voltage as V_r . Calculate ripple factor as,

$$\text{Ripple factor } r = V_r / V_{dc}.$$

7. Tabulate all observations.

Input ac	V_{dc}	V_{rms} at dc out	r
... volt	... V	... V

b. To study full wave (centre tapped) rectifier circuit.

1. Connect the circuit as shown in fig 8, this will bring diode D3 in the circuit and it becomes a full wave rectifier circuit. Note that there is only one more patch cord is inserted in the previous circuit to convert half wave to full wave.

2. Remaining steps are same as before.

c. The full wave bridge rectifier circuit.

1. Connect the circuit as shown in fig 9. Now the four diodes are in circuit.

2. Remaining steps are same as before.

d. The shunt capacitor filter with full wave rectifier.

1. Connect the circuit as fig 10, it will bring C1 in the circuit. Note there is one more patch cord is used to convert the full wave rectier circuit with capacitor filter.

2. Note the introduction of C1 increase the dc voltage since capacitor is

goes to charge for V_m value.

3. Measure the V_{dc} and V_r across the RL.
4. Made the half wave circuit disconnecting the patch cord between socket 2 and 3. Note the V_{dc} and V_r across RL.
5. Tabulate the result. Compare the reduction of V_r in full wave (due to ripple frequency).

e. The series inductor filter.

1. Plug out the patch cord connected between L. Disconnect C1 from the circuit, refer to fig 11.
2. Note V_{dc} and V_r voltage across the RL.
3. Convert the circuit in half wave as exp d and note V_{dc} and V_r .
4. Tabulate the result.

f. The L filter.

1. Refer to fig 12.
2. The remaining process is same as before.

g. Pye filter.

1. Connect the circuit as fig 13.
2. Remining procedure as before.

Prepare a table from the results obtained for each experiment done and write the performance of each configuration.

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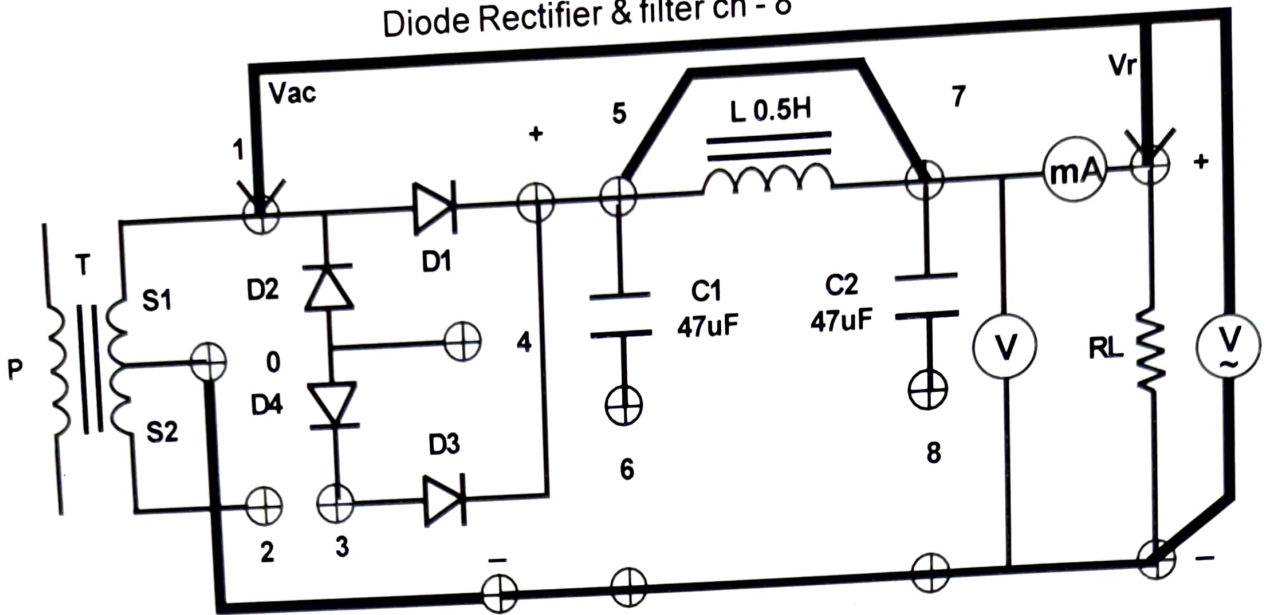


Fig 7 : Connection diagram for *half wave* rectifier circuit.

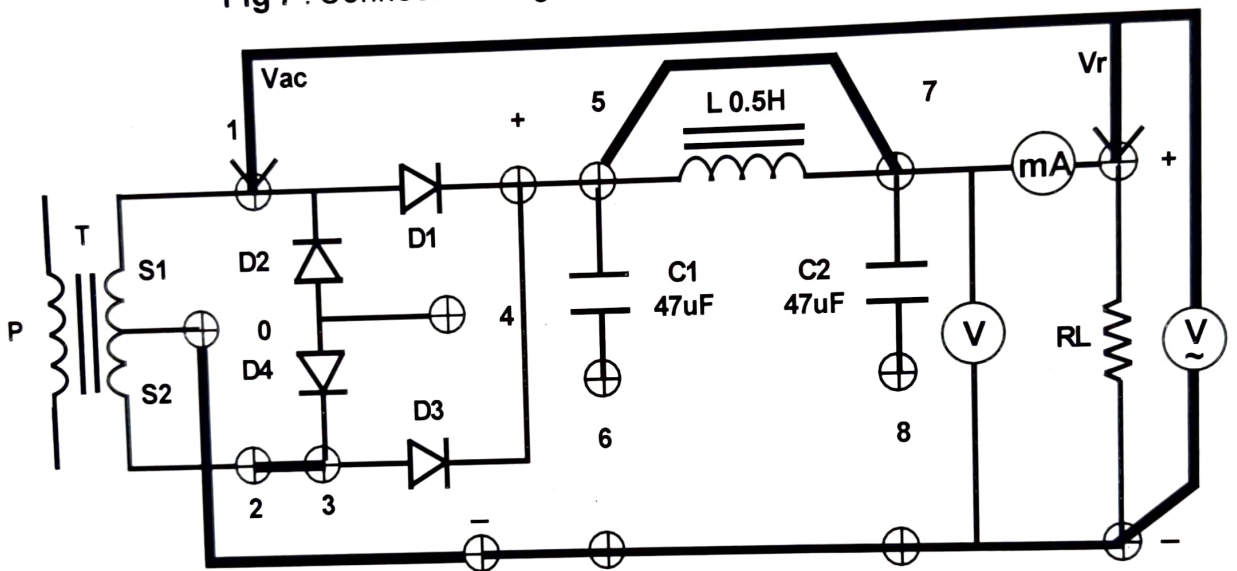


Fig 8 : Connection diagram for *full wave* rectifier circuit.

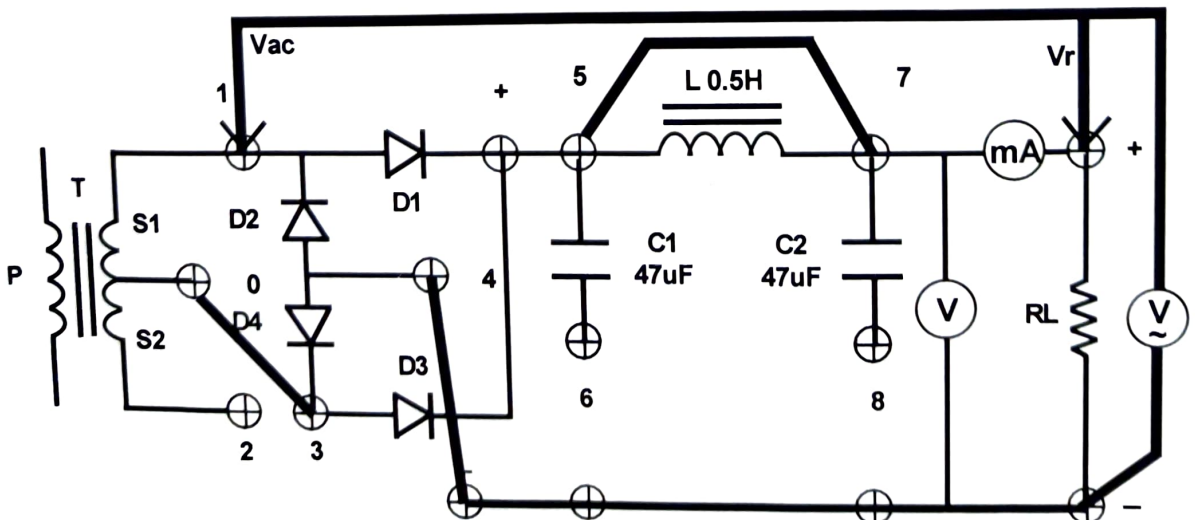
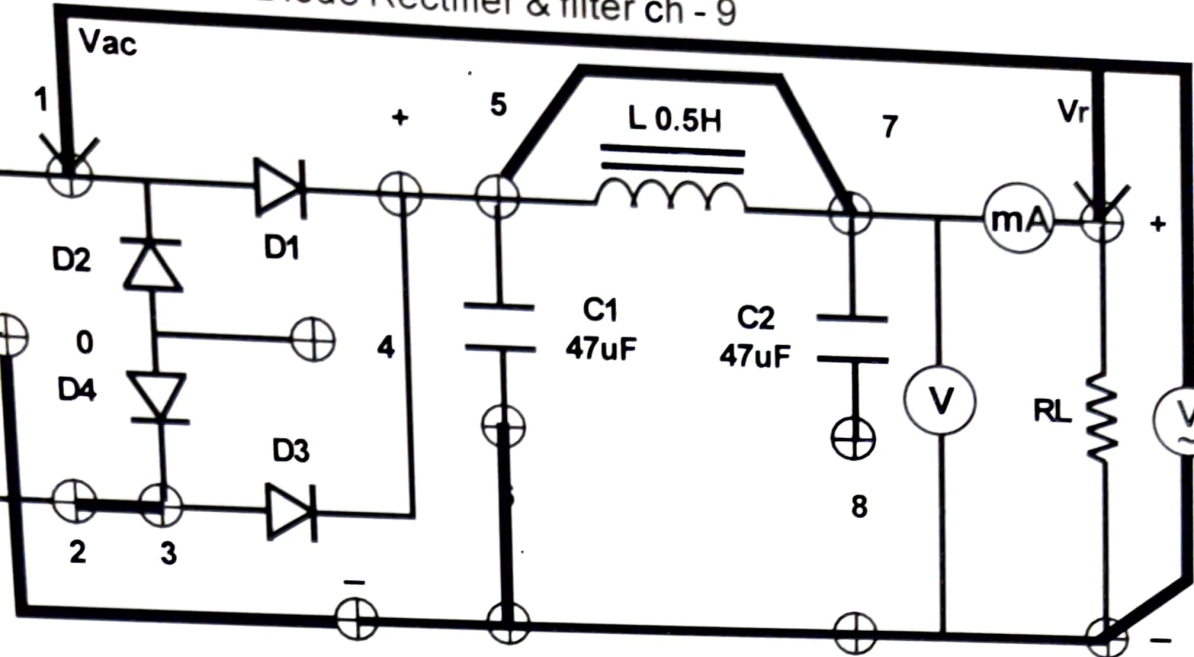
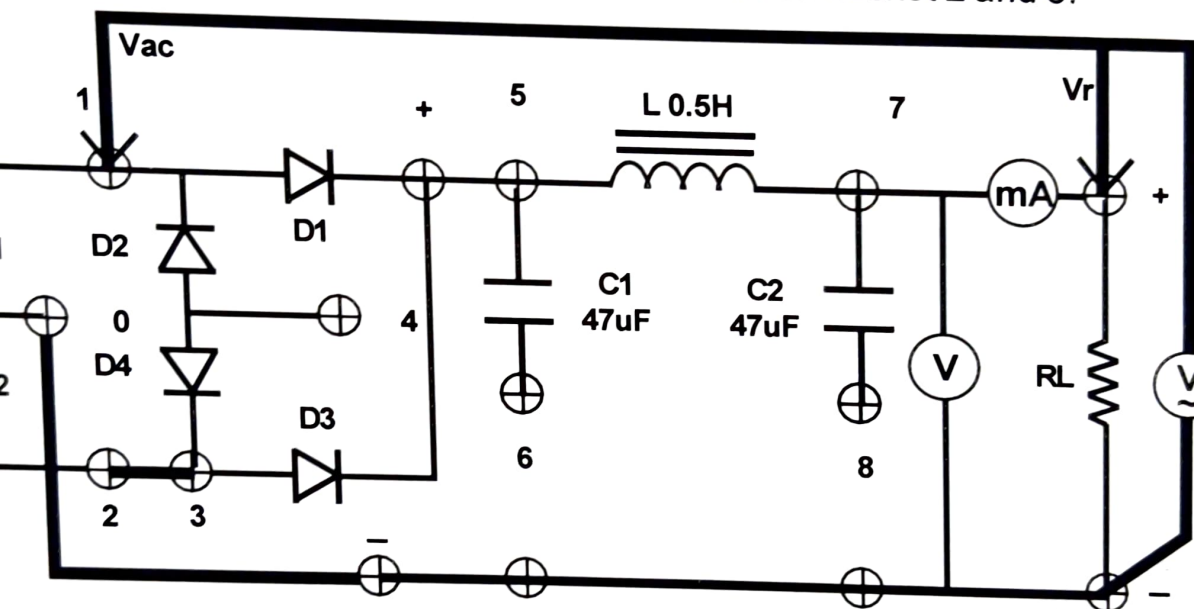


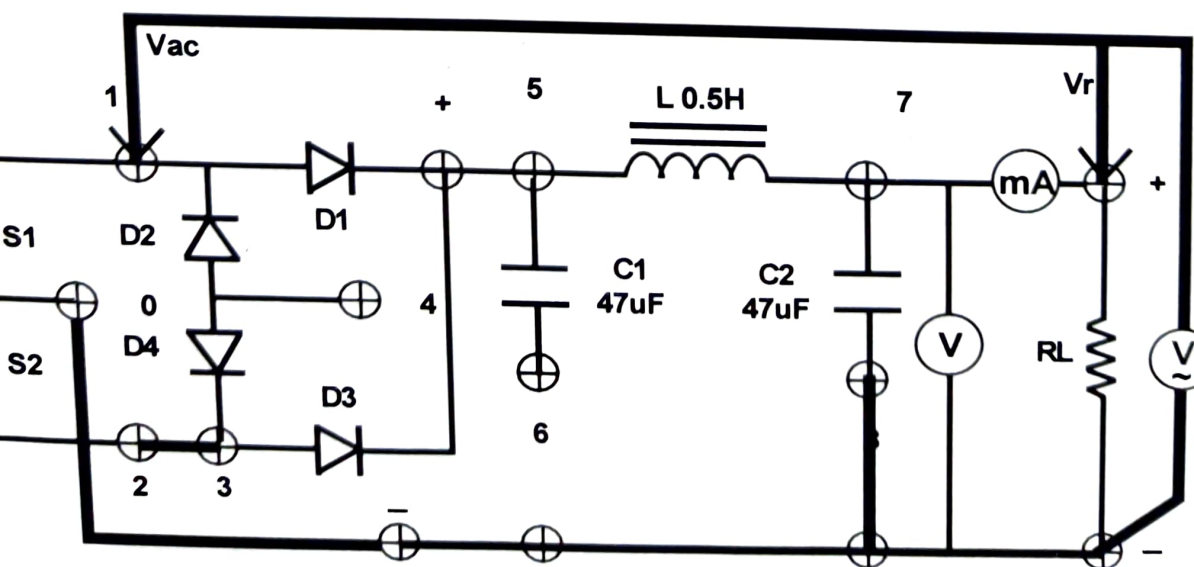
Fig 9 : Connection diagram for *bridge* rectifier circuit.



Connection diagram for *full wave* rectifier with *shunt capacitor filter* circuit. For half wave remove patch cord connected between socket 2 and 3.



Connection diagram for *full wave* rectifier with *series inductor filter* circuit. For half wave remove patch cord connected between socket 2 and 3.



Connection diagram for *full wave* rectifier with '*L*' filter circuit. For half wave

Table for comparison

Ripple factor:	Capacitor filter	Inductor filter	L type	Pye
Half wave :
Full wave :

To observe the waveforms upon C.R.O connect its leads across the given RL sockets in such way that C.R.O ground lead with -ve and hot lead with +ve socket. The fig 12,13 circuit is also reffered as dc power supply.

h. To evaluate line and load characteristics of dc supply.

1. Connect the circuit as fig 12.
2. Adjust RL for minimum load current.
3. Note input ac (V_{ac}), output dc (V_{dc}) and load current (I_L).
4. Now adjust RL for maximum load current shown by meter.
5. Note input ac (V_{ac}'), output dc (V_{dc}') and load current (I_L').

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Sr No.	Vac	Vdc	IL mA
1. V V mA (min)
2. " (max)

6. Draw a load line curve as shown in fig 14. From curve find out ΔV . Fix an operating point at center of the curve. The change in output voltage for min to max load current is $= \Delta V$

$$\text{The load regulation \%} = \left[\frac{\Delta V}{V_{Q\text{point}}} \times 100 \right]$$

Note : If the drop in input Vac accounted then regulation % is found better.

the ripple factor may taken from exp f results.

For line regulation, a variac can be used to bring ac supply up and down for $\pm 10\%$, and output dc is measured with RL fixed for $V_{dc} = Q \text{ point}$.

$$\text{The line regulation \%} = \left[\frac{\Delta V_{dc}}{\Delta V_{ac}} \times 100 \right], \text{ where } V_{dc} = Q \text{ point.}$$

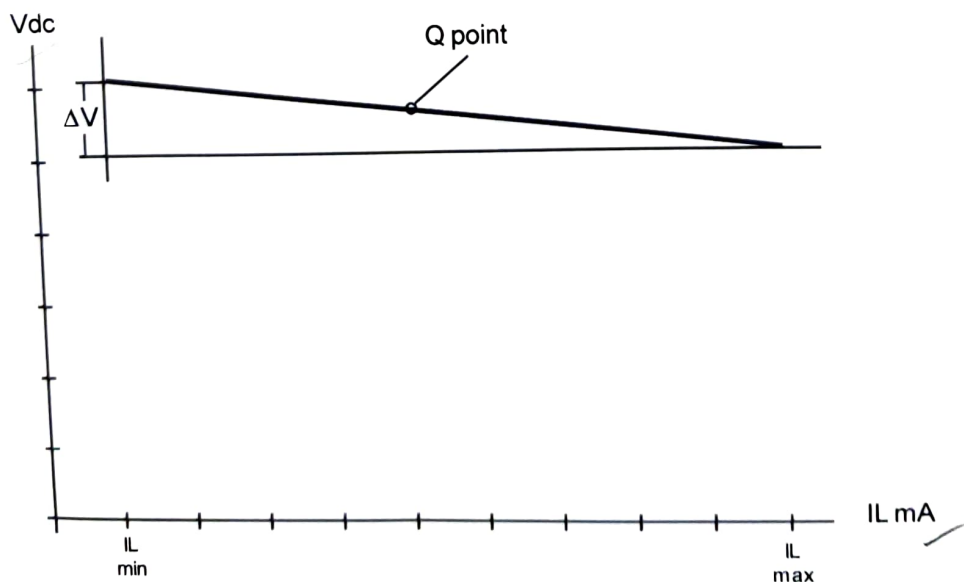


Fig 14 : plot of load line characteristics of power supply