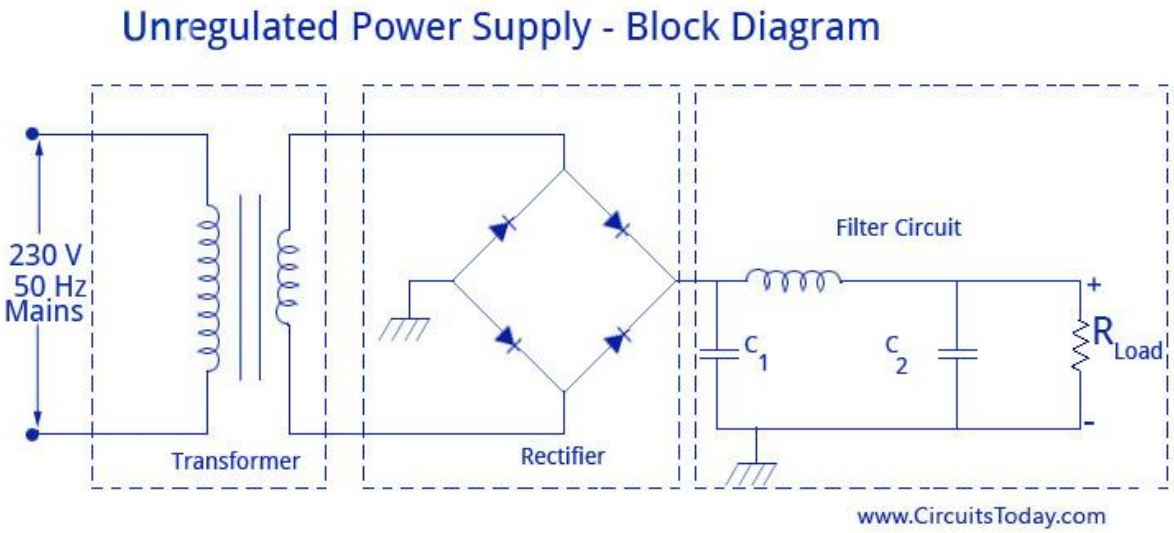
OP-AMP and Regulated Power Supply-

Operational amplifiers (OP-AMP): Differential amplifier – dual input and balanced output.

Concept of an ideal OP-AMP, OP-AMP Characteristics for IC 741, inverting and noninverting amplifiers with feed back. Derivation of expression for voltage gain, Frequency response.

Regulated power supply: Block diagram, bridge rectifier- derivation of expressions for efficiency, ripple factor. Capacitor filter. Voltage regulator using Zener diode.

Block Diagram of a Regulated Power Supply-



Block Diagram of an Op-Amp-

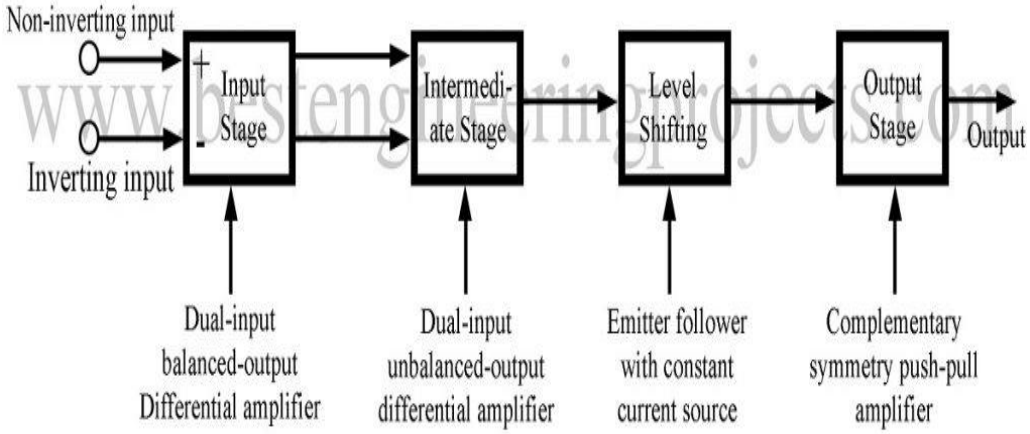
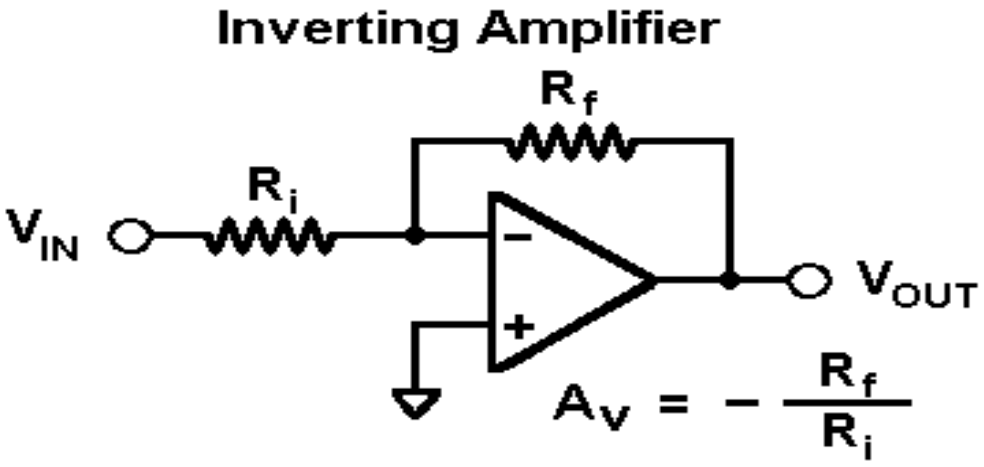
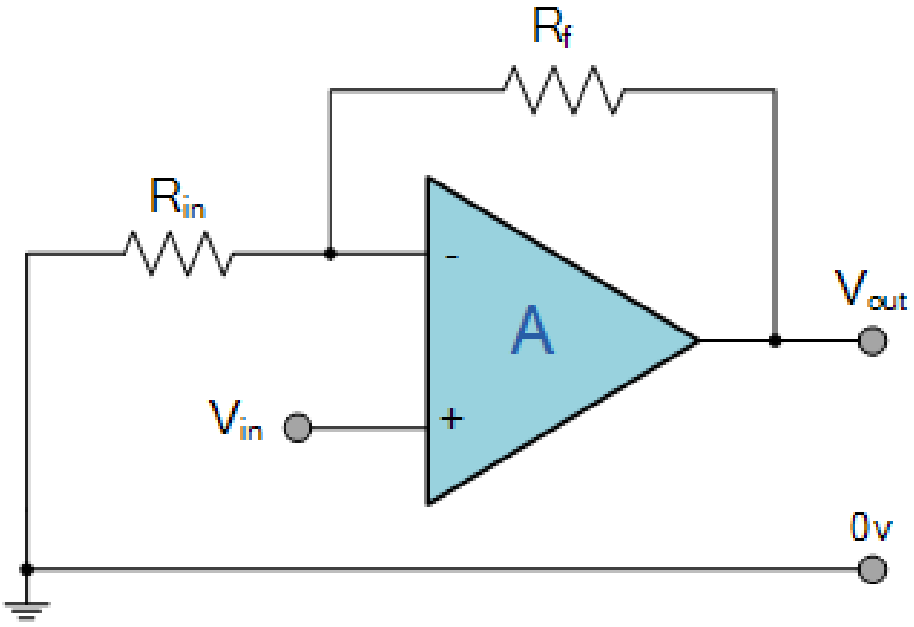


Figure 1: Block Diagram of a Typical Op-amp



Non-Inverting Amplifier-

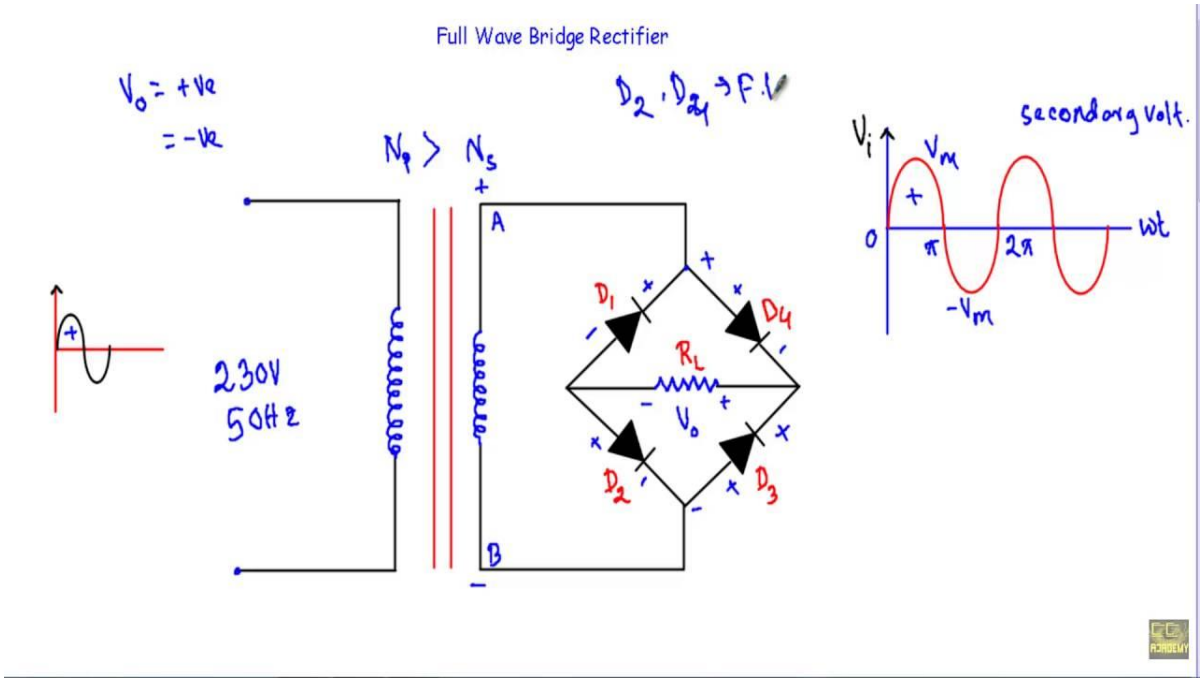


Characteristics	Ideal Op Amp	Real Op Amp
Infinite Voltage Gain	An ideal op amp will have infinite voltage gain. Op amps are devices that many times are used to function as amplifiers. A voltage is input into the op amp and as output, it produces the voltage	A real op amp can only produce a finite gain.

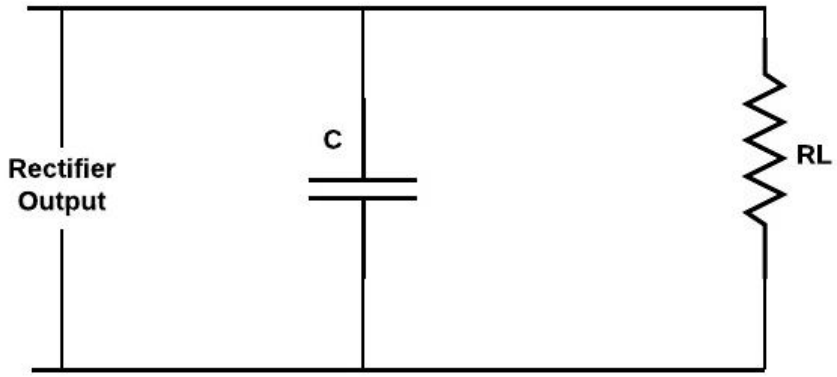
	amplified. An ideal op amp will produce mega-gain, practically, it will be able to produce infinite gain. It will amplify the signal infinite times over so that we can have as much gain as we'd ever need.	
Infinitely high input impedance	An ideal op amp will have infintely high input impedance. This will ensure that the op amp causes no loading in the circuit. The lower the input impedance, the more current that an op amp will draw. The higher the impedance, the lower the current that an op will draw. We want high input impedance so that the op amp doesn't disturb the original circuit by pulling current from it. To do this, we need infinitely high input impedance.	A real op amp has finite input impedance. Even though many types of op amps, such as MOSFETs, have extremely high input impedance, in the order of teraohms, it is still finite.
Zero Output Impedance	An ideal op amp will have zero output impedance. When an op amp produces its output signal, we want the op amp to have zero voltage so that the maximum voltage will be transferred to the output load. Voltage is divided in a circuit according to the amount of impedance present in a circuit. Voltage drops across a component of higher impedance. In order for the voltage to drop across the output load, that load must be of greater impedance than the output of the op amp. This is why, ideally,	A real op amp will always have some output impedance, though it is low. A typical value can be 75Ω.

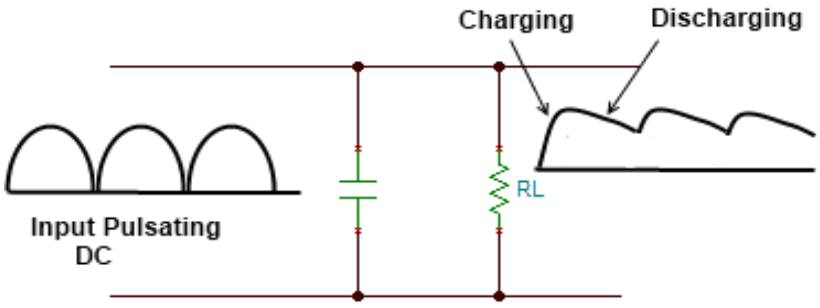
	we want the output impedance of the op amp to be zero	
Gain Independent of Frequency	In an ideal op amp, the gain that the op amp produces will be independent of frequency. This means that regardless of the frequency of the input signal going into the op amp, the gain that is produced will be constant and good across all frequencies.	In real op amps, the gain that is produced is only for a certain bandwidth of frequencies. Outside of this bandwidth, the gain that the op amp produces will decline.
Zero Input Voltage Offset	In an ideal op amp, if no voltage is applied to the inverting and noninverting input pins, the op amp will output a voltage of 0, since there is no difference at all of the voltage applied to the 2 input pins.	A real op amp will have slight offset even if the voltage applied to the pins are the same. To correct this offset, voltage must be applied to the offset pin.
Positive and Negative Voltage Swings to Supply Rails	In an ideal op amp, the ac voltage which is fed into the op amp to be amplified will swing all the way up for the DC positive supply rail and all the way down for the DC negative supply rail, making 100% efficient use of the DC voltage supplied to an op amp.	In real op amps, the amplified signal will not fully reach the DC supply rails. They will fall short of it.
Output swings instantly to the correct value	In an ideal op amp, the output will swing instantly to the amplified voltage value. There will be no time delay between the time the voltage is input into the op amp till the time it is output. It will all be instantaneous.	In real op amps, the amplified signal will take time to reach the fully amplified voltage value. This is determined by the slew rate of the op amp.

Full Wave Bridge Rectifier-



Capacitor Filter-





Zener as a voltage Regulator-