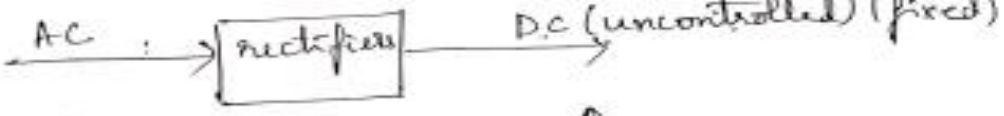
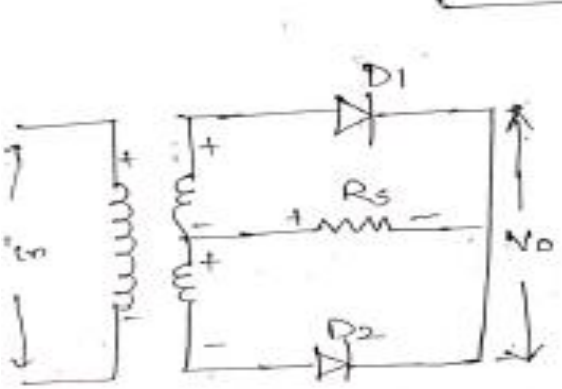
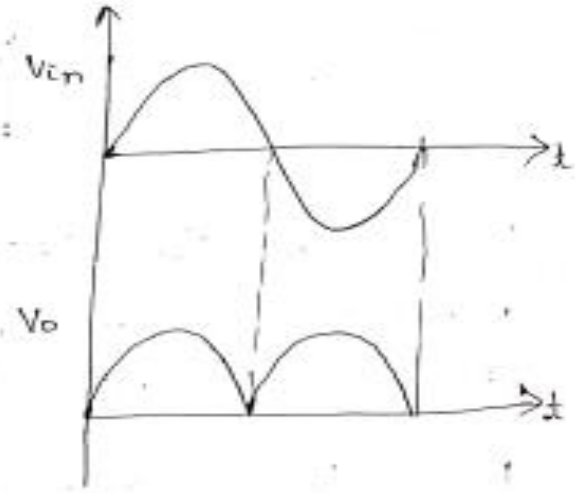
1. Mention and explain different types of power electronic converters. Draw their output/input characteristics.

Different types of power electronic converters.

AC rectifiers (uncontrolled)

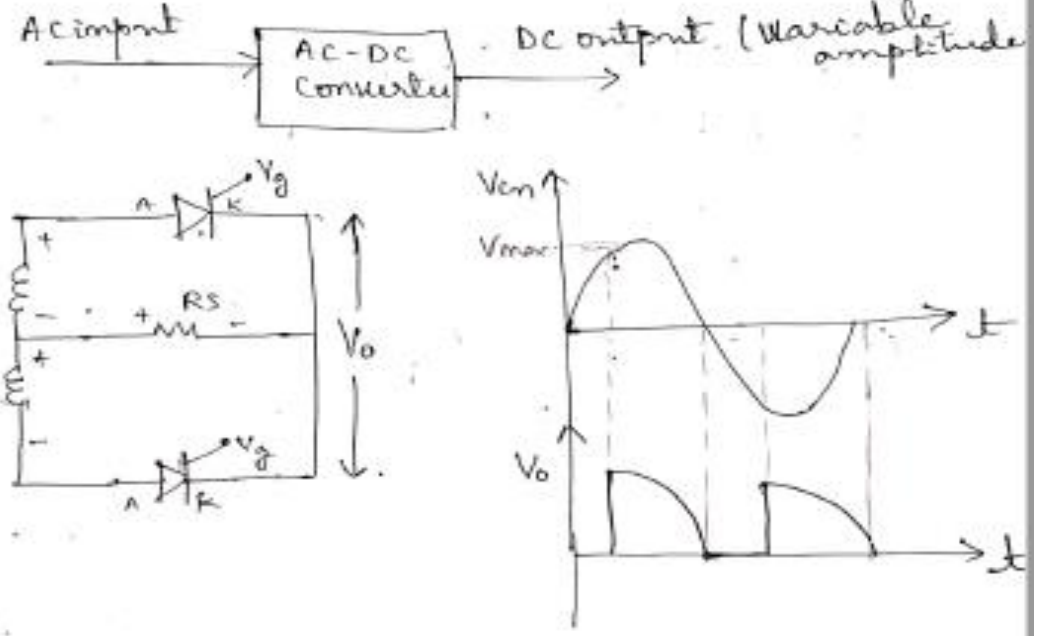






The input to the rectifier is an AC voltage. The diodes are used in this converter to give a fixed dc voltage signal at the output. Since, the diodes are uncontrolled devices, the average dc voltage output cannot be varied to the desired level.

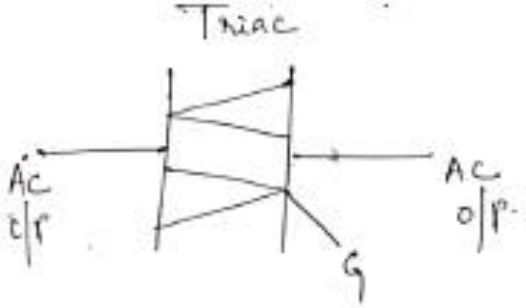
AC-DC Converters (controlled)

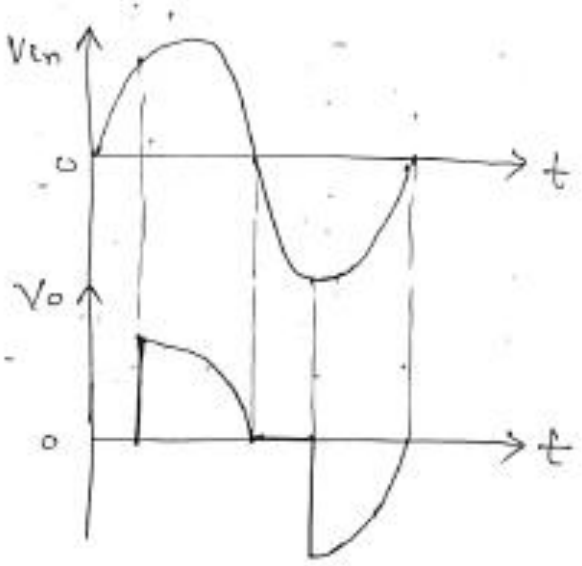


The AC-DC converter uses SCR (Silicon controlled rectifiers) to give a controlled dc output voltage.

i.e The average dc output can be varied according to the requirement.

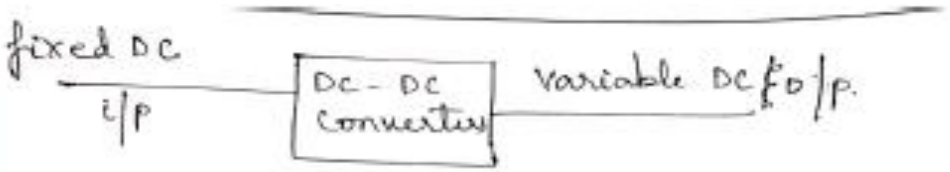
Applications: normally used in heating, lighting, fan regulator applications.

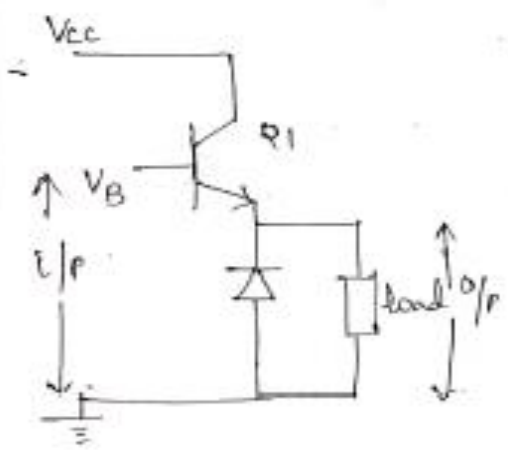


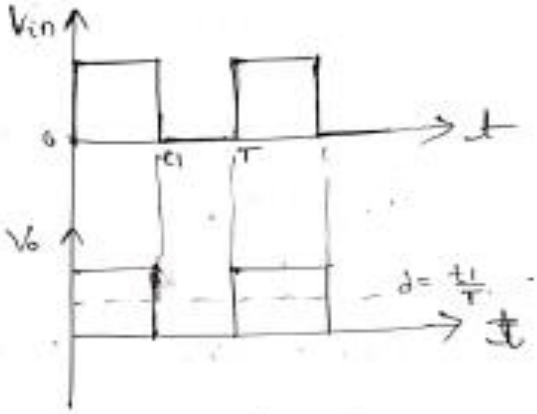


AC-AC converters use Triac. The input will be a fixed voltage or frequency AC. The output can be controlled to give a required variance in the input, be it frequency or voltage. Application: motor drives etc. heatings

DC-DC converters







The DC to DC converter uses a BJT to regulate the o/p.

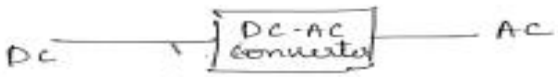
The average power at the output can be varied by changing the conduction time 't_1' of the transistor 'Q1'.

Application :- Battery charger circuits

Large power supplies etc.

The DC to DC converters are also called as choppers.

DC to AC converters



They are normally used as inverters.
The DC power source is mainly batteries. The output is used to run various applicati

Applications of DC-AC converters

i) UPS
ii) Inverter
iii) HVDC transmission.

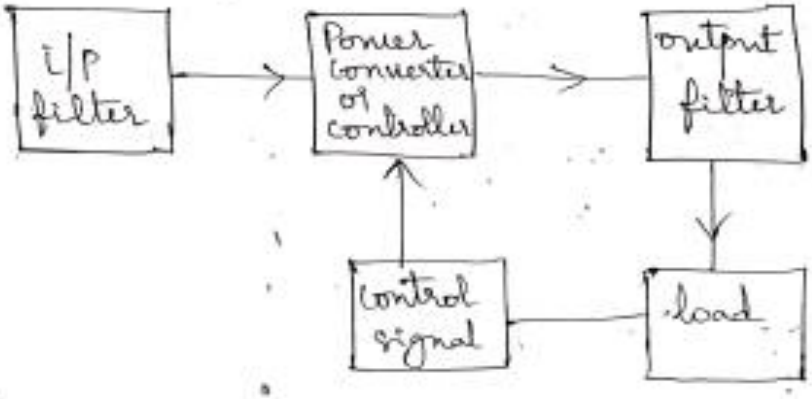
2. What are the peripheral effects of power electronic components and mention its remedies

Peripheral effects.

In a electronic system, the semiconductor power devices introduce voltage and current harmonics in the power system as well as the output signal of the system.

These harmonics, will distort the output of the system as well as cause an interference in the communication and signalling circuit of the system.

To reduce these effects, filters are added at both, the input and output end of the system.



To resolve the issue of the harmonics, it is necessary to understand the quality of power and contents of the harmonics.

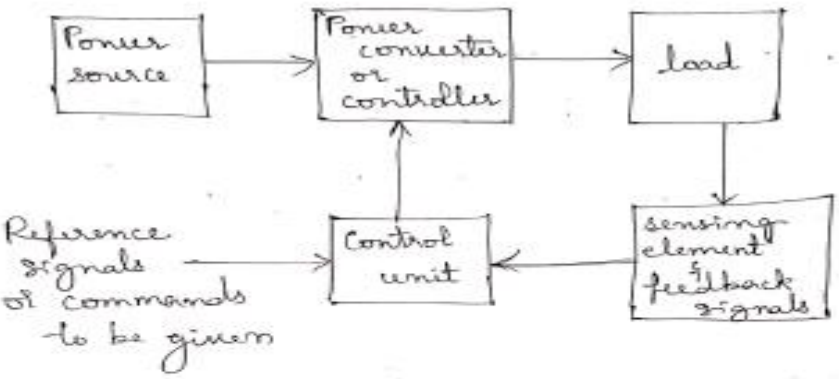
To get this information we need to analyse various information such as the total harmonic distortion, harmonic factor and the power factor at the input of the system.

The harmonics can also be reduced by proper ground shielding.

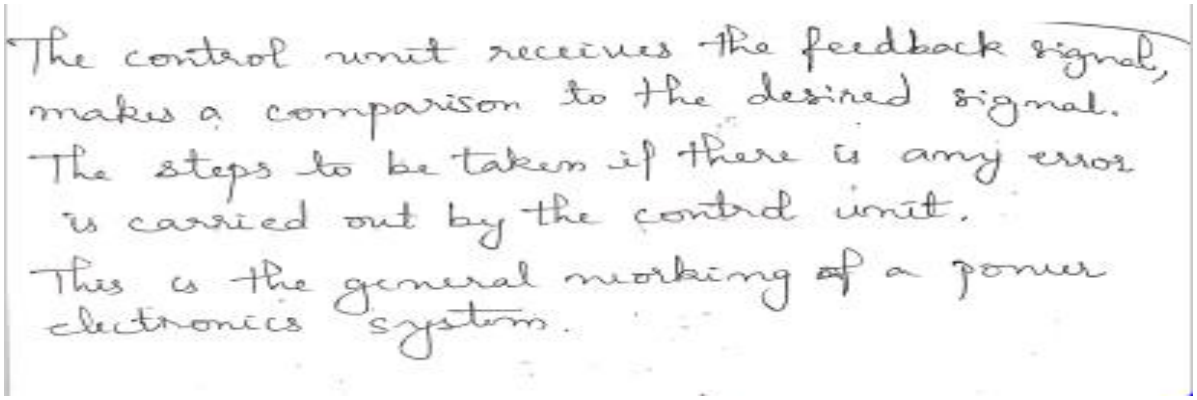
3. What is power Electronics? Draw a neat block diagram of generalized power converter system and explain

Power
The branch of electronics which deals with system of high power rating is called as power electronics.

Power converter system



- The power converters or controllers in the system can be any power semiconductor devices such as SCR, SITH, GTO etc.
- The power source can be either AC or DC according to the application. The power converter controls or converts the input signal into that suitable for the load.
- The sensing element consists of a sensor which takes i/p from the load and gives a feedback signal to the control unit. It takes the o/p signal and compares it with the actual signal to give feedback.



4. The BJT is specified to have β in the range of 8 to 40. The load resistance Rc = 11Ω. The dc supply voltage is V_{CC} =200V and the input voltage to the base circuit is V_B =10V. If V_{CE}(sat) =1.0V and V_{BE}(sat) =1.5V. Find

a. The value of R_B that results in saturation with a overdrive factor of 5.

b. The forced β_f

c. The power loss P T in the transistor.

Given.

$\beta = 8$.

$R_C = 11\Omega$

$V_{CC} = 200V$.

$V_B = 10V$.

$V_{CE(sat)} = 1.0V$

$V_{BE(sat)} = 1.5V$.

$R_B = ?$ $\quad ODF = 5$

$$ODF = \frac{I_B}{I_{B(sat)}}$$

$$I_B = \frac{V_B - V_{BE(sat)}}{R_B}$$

$$I_{B(sat)} = \frac{I_{C(sat)}}{\beta}$$

$$I_{C(sat)} = \frac{V_{CC} - V_{CE(sat)}}{R_C} = \frac{200V - 1.0V}{11\Omega}$$

$$= 18.09A.$$

$$I_{B(sat)} = \frac{I_{C(sat)}}{\beta}$$

$$= \frac{18.09}{8}$$

$$= 2.26\ A$$

Given $ODF = 5 = \frac{I_B}{I_{B(sat)}}$

$$\Rightarrow I_B = 5 \times I_{B(sat)}$$

$$= 5 \times 2.26$$

$$= 11.3\ A$$

$$R_B = \frac{V_{BB} - V_{BE(sat)}}{I_B}$$

$$= \frac{10V - 1.5V}{11.3\ A}$$

$$= \boxed{0.752\ \Omega}$$

The forced β

$$\beta_f = \frac{I_{C(sat)}}{I_B}$$

$$= \frac{18.09A}{11.3\ A}$$

$$\boxed{\beta_f = 1.6}$$

Power loss, $P_T = V_{CE}^{(sat)} I_C^{(sat)} + V_{BE}^{(sat)} I_B$

$$= (1)(18.09) + (1.5)(11.3)$$

$$= \boxed{35.04\ W}$$

5. For V_{CC}=100V, V_B =10V, R_B = 0.8Ω, Rc = 12Ω, V_{CE}(sat) =1.0V, V_{BE}(sat) =1.5V and β=10 Find

a) The forced β_f
b) ODF
c) Power Loss

Given

$V_{cc} = 100\,V$

$V_B = 10\,V$

$R_B = 0.8\,\Omega$

$R_c = 12\,\Omega$

$V_{CE(sat)} = 1.0\,V$

$V_{BE(sat)} = 1.5\,V$

$\beta = 10.$

$$\beta_f = \frac{I_{c(sat)}}{I_B}$$

$$I_{c(sat)} = \frac{V_{cc} - V_{CE(sat)}}{R_c}$$

$$= \frac{100 - 1}{12}\ A$$

$$= 8.25\,A$$

$$I_B = \frac{V_B - V_{BE(sat)}}{R_B}$$

$$= \frac{10 - 1.5}{0.8} A$$

$$= 10.625 A$$

$$\beta_f = \frac{I_{C(sat)}}{I_B} = \frac{8.25 A}{10.625 A}$$

$$\boxed{\beta_f = 0.77}$$

$$ODF = \frac{I_B}{I_{B(sat)}}$$

$$I_{B(sat)} = \frac{I_{C(sat)}}{\beta} = \frac{8.25}{10} = 0.825$$

$$\Rightarrow \quad ODF = \frac{10.625}{0.825} = \boxed{12.878}$$

Power loss $= V_{BE(sat)} I_B + V_{CE(sat)} I_{C(sat)}$

$= 1.5 \times 10.625 + 1 \times 8.25$

$= 24.18$

$\simeq \underline{24\,W}$