Power Electronic

Final paper.

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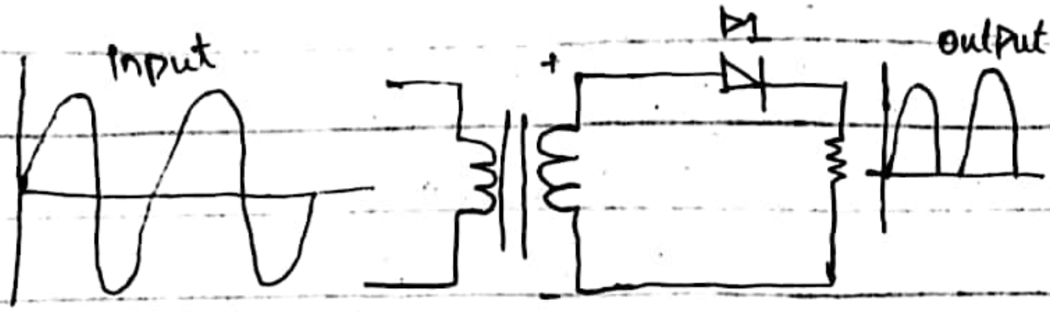
13169.

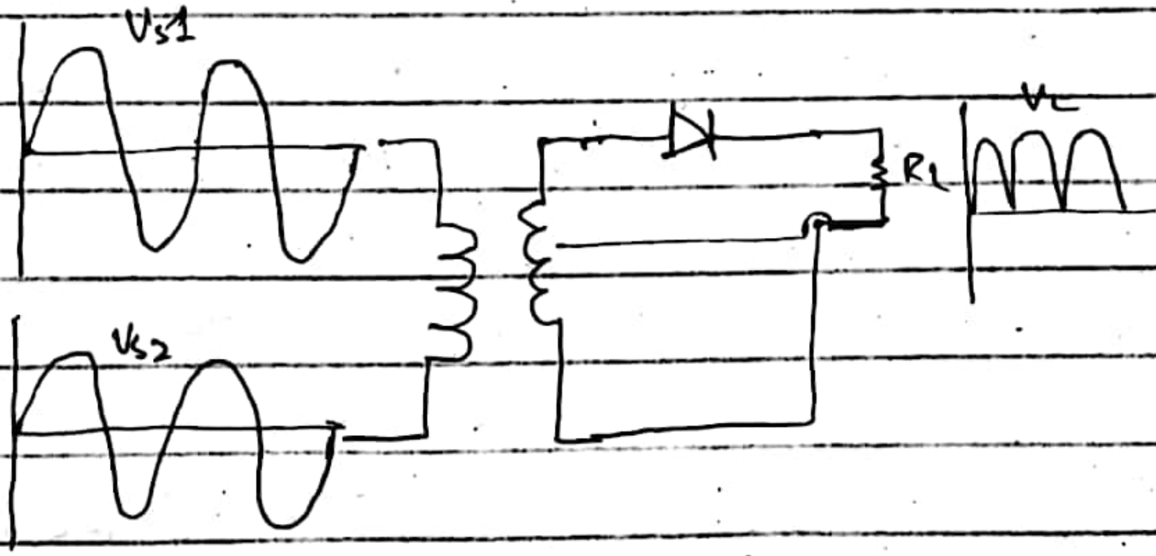
Question # 1.
Answer:-

Difference b/w Half & full wave Rectifier:-

A half wave Rectifier & full wave Rectifier have significant difference. A rectifier convert AC voltage into Pulsating DC Voltage. A half wave rectifier is an electronic circuit which converts only one-half of the AC cycle into pulsating DC. It utilizes only half of AC cycle for the conversion process. One the other hand full wave rectifier is an electronic circuit which converts entire cycle of AC into Pulsating DC. The half wave Rectifier is unidirectional; it means it will allow the conduction in one direction only. that's why it can convert positive half only or negative half only into DC Voltage. This is the Reason that it is called Half wave Rectifier. While full wave Rectifier is bi-directional, it conducts for positive half as well as negative half of the cycle. Thus it is termed as full wave rectifier.



Half wave rectifier.



Full wave Rectifier.

Part (2).

Basic rectifier circuits several type of rectifier are available: Single Phase & three phase, half wave & full wave, controll & uncontrolled etc. for a given application, the type used is determined by the requirements of that application. In general the types of rectifiers are

(1) Uncontrolled Rectifier:- Provide a fixed dc output voltage for a given Ac supply where diodes are used only.

(2) Controlled Rectifier:- Provides an adjustable dc output voltage by controlling the phase at which the devices are turned on. Where thyristors & diodes are used.

Q.#12

Answer:

Given data:-

ID : 13169

$V_m = 69\,V.$

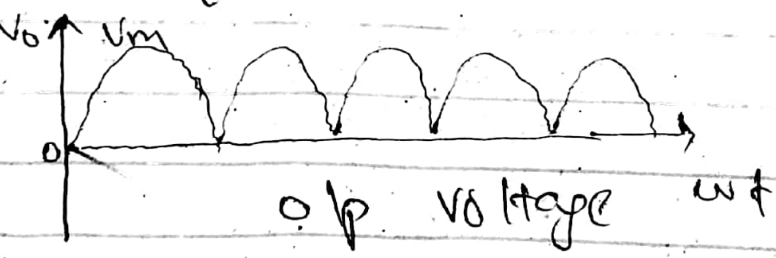
$R_L = 13\,\Omega$

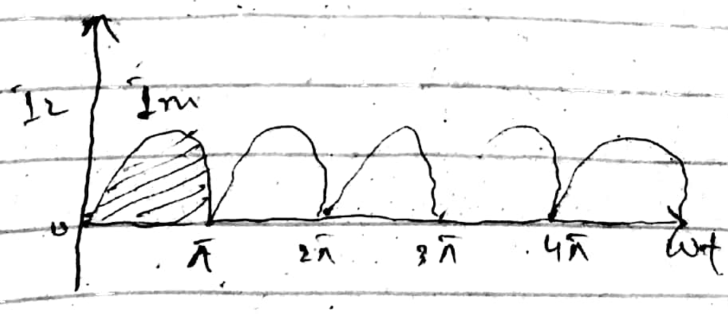
$I_m = V_m / R_L = 69/13$

$I_m = 5.30\,A.$

(i) $I_{dc} = ?$

first we find I_{dc} in full wave rectification.





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$$I_{dc} = \frac{\text{area under the load current over full cycle}}{\text{period of cycle}}$$

$$I_{dc} = \int_0^{\pi} \frac{I_m \sin\omega t \, d(\omega t)}{\pi}$$

$$I_{dc} = \frac{I_m}{\pi} \int_0^{\pi} \sin\omega t \, d(\omega t)$$

$$I_{dc} = \frac{I_m}{\pi} \left[-\cos \omega t \right]_0^{\pi}$$

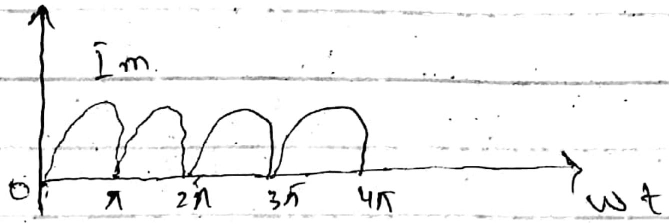
$$I_{dc} = \frac{I_m}{\pi} \left[-\cos \pi - (-\cos 0) \right]$$

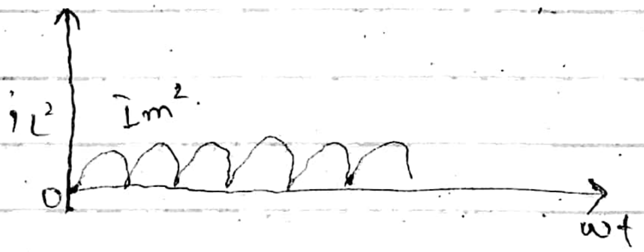
$$I_{dc} = \frac{I_m}{\pi} [1 + 1]$$

$$I_{dc} = \frac{I_m}{\pi} [2]$$

$$\boxed{I_{dc} = \frac{2 I_m}{\pi}}$$

(3) $I_{rms} = ?$





Now

$$I_{rms} = \sqrt{\frac{\text{A. of sq. of i. current over full cycle}}{\text{period of the sq. w.form}}}$$

$$I_{rms} = \sqrt{\frac{\int_0^{\pi} I_m^2 \sin^2 \omega t \; d(\omega t)}{\pi}}$$

$$I_{rms} = \sqrt{\frac{I_m^2}{2\pi}\int_0^{\pi} 2\sin^2 \omega t \; d(\omega t)}$$

$$I_{rms} = \sqrt{\frac{I_m^2}{2\pi}\int_0^{\pi} \not{2\sin} (1 - \cos 2\omega t) \; d(\omega t)}$$

$$I_{rms} = \sqrt{\frac{I_m^2}{2\pi}\left[\omega t - \frac{\sin 2\omega t}{2}\right]_0^{\pi}}$$

$$I_{rms} = \left[\frac{I_m^2}{2\pi}\left[\pi - \frac{\sin 2\pi}{2} - 0 + \frac{\sin 2(0)}{2}\right]\right]^{1/2}$$

$$I_{rms} = \sqrt{\frac{I_m^2}{2\pi} \times \pi}$$

$$I_{rms} = \frac{I_m}{\sqrt{2}}$$

Putt the values.

$$I_{rms} = \frac{5.30}{\sqrt{2}} \Rightarrow \boxed{3.74\ A = I_{rms}}$$

And;

$$V_{rms} = I_{rms} \times R_L$$

$$= \frac{I_m}{\sqrt{2}} \times R_L$$

$$V_{rms} = \frac{V_m}{\sqrt{2}}$$. Putt values.

$$V_{rms} = \frac{69}{\sqrt{2}}$$

$$\boxed{V_{rms} = 48.79\ V.}$$

CQ#3 ANSWER

Buck Chooper:-

1, => Output voltage is less than i/p voltage.

2, => The therister in the circuit acts as a switch.

3, When therister is ON, supply voltage appear across the load.

4, when therister is off, the voltage across the Load will be zero.

5, Practicle arrangment includes an Inductor L and diode which are used to eliminate current pulsation providing a smoth DC current ~~pulsation~~.

6) with S closed, D is off and it remain off and it remain off as long as S is ON.

7, The i/p current build up ~~expanding~~ exponentially and flow through L & Load.

8) Vo equal to V_1.

9, with S off or open, the current through I delay to zero.

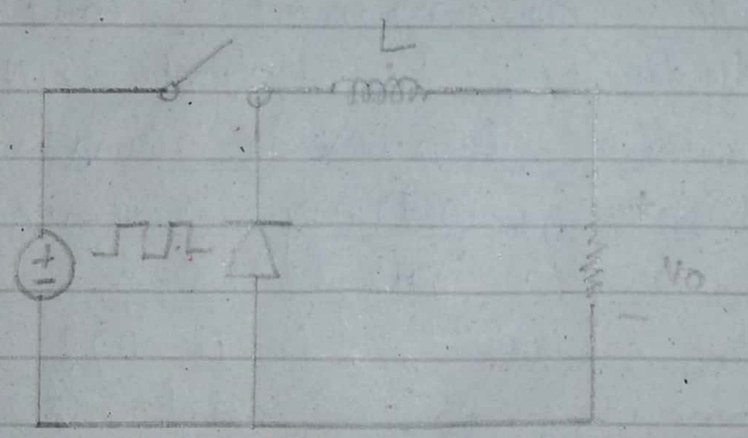
10, This cause Inductive Voltage with opposite polarity across the Inductor (L).

11) V_2 forward bias diode D.

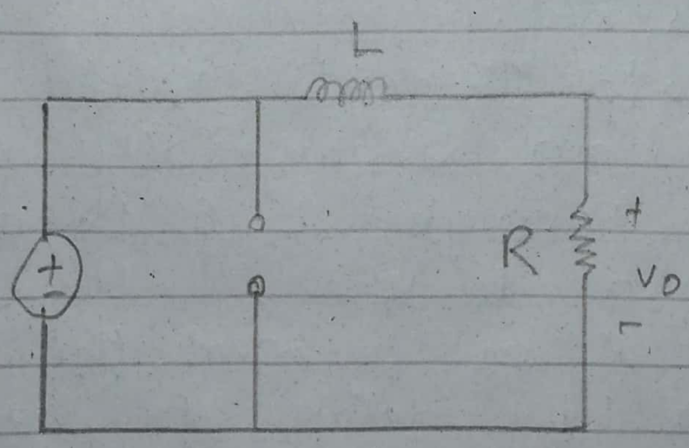
12) Current flows through L & Load & Diode D.

13) This arrangment permit the use of simple filter inductance L to provide a satisfactory smoth DC Load Current.

14) With high switch frequency, smaller inductence is suffi-cient to get desired output.



Circuit of Buck Converter.



Circuit when closed.

Example:

ID : 13169

Given data:

DC source V_{in} = 50V

Duty cycle D = 69%

Load of R = 13 Ω

Switching frequency = f = 20 KHz

To find:

1) V_{out}, 2) I_{out}, 3) I_{in}, 4) L_{min}

Soln:

1) V_{out}

We know that

$V_{out} = \alpha \times V_s$ OR $D \times V_s$ →(1)

Here α is duty cycle, which 69% = 0.69

Putting by (1).

(1) ⇒ $V_{out} = (0.69)(50)$

$$V_{out} = 34.5\ V$$

2) $\bar{I}_{out} = V_o / R \Rightarrow 34.5/13$

$\bar{I}_{out} = 2.65 \text{ A}$

3) $\bar{I}_{in} = ?$

∵ we knew that.

$$I_o = \frac{I_i}{\alpha \cdot RD}$$

$I_i = I_o \times D. = (2.65)(0.69)$

$I_i = 1.828.$

4) Inductor:

$$L = \frac{T_{OFF} \times R}{2}.$$

Suppose $T_{OFF} = 0.009$.

$$L = \frac{0.009 \times 13}{2}$$

$L = 0.0585 \text{ H}$

Q4

Boost Choppers:-

=> The output voltage is more than the input voltage by several time.

=> L is used to provide smoth input current.

=> with S ON, The L is connected to the supply.

=> The SCR (S) acts as the switch which work in PINTA. mode.

=> When S is open, the current passes and energy stored in L is transferred to C thgh D.

=> The current that was flowing through S now flow through L, D & C to load.

=> Energy stored in inductor is released to Load.

$V_o = V_i + V_L$

⇒ Vo is always higher then V_1 as polarity of Inductorer voltage V_L is same as Vs.

$$W_{OFF} = (V_0 - V_i) * I_i * T_{OFF}$$

⇒ Since losses are neglect, the energy stored transffered during T_{OFF} by Lmin be equal to energy gained during T_{ON}.

$$W_{ON} = W_{OFF} = V_i I_i T_{ON}.$$

$$= (V_0 - V_i) * I_i * OFF$$

$$V_0 = V_i \left(1 + \frac{T_{ON}}{T_{OFF}}\right) = V_i \left(\frac{T}{T_{ON}}\right.$$

$$V_i = \left(\frac{1}{1 - \frac{T_{ON}}{T}}\right) = V_t \left(\frac{1}{1-d}\right)$$

Thus V_i is always greater than V_1.

$$\Rightarrow P_1 = P_0 \rightarrow V_1 I_1 = \frac{V_0^2}{R} \Rightarrow I_1 = \frac{V_0^2}{V_L} * \frac{1}{R}$$

$$\Rightarrow I_0 = I_1 * \frac{T_{off}}{T} \Rightarrow I_0 = I_1 (1-d).$$

$$\Rightarrow P_0 = P_1 \Rightarrow V_1 I_1 \Rightarrow \frac{V_0^2}{R} = \frac{V_i^2}{(1-d)^2} * \frac{1}{R}.$$

$$\Rightarrow I_1 = \frac{V_1}{(1-d)^2} * \frac{1}{R}.$$

$$\Rightarrow I_L = \frac{V_1}{(1-d)^2} * \frac{1}{R}.$$

$$\Rightarrow I_L = \frac{I_{max} + I_{min}}{2} = I_1.$$

$$\Rightarrow I_{max} + I_{min} = 2 * I_1$$

$\Rightarrow$ Votage across L is;

$$V_L = V_1 = L * \frac{di}{dt}$$

$$\Delta I_1 = \frac{V_1}{L} * T_{ON}.$$

Example:

Given data:

ID = 13169

$V_{in} = 50$ V. 69%

D. cycle = $D = 0.69$.

Resister = $R = 13$

Frequency = $f = 20$ kHz.

Soln:

(1)

$$V_{out} = V_1 \left(\frac{1}{1-d} \right).$$

$$= 50 \left(\frac{1}{1-0.69} \right) \Rightarrow \frac{50}{0.31}.$$

$$\boxed{V_{out} = 161.29 \text{ V}}$$

2)

$I_{out} = ?$

$$I_o = I_1 (1-d) \quad — \quad (1).$$

$$I_1 = \frac{V_i}{(1-d)^2} \times \frac{1}{R}. \Rightarrow \frac{50}{(1-0.69)^2} \times \frac{1}{13}$$

$$I_1 = \frac{50}{0.0961} \times \frac{1}{13}$$

$$\boxed{I_1 = 40.022 \text{ A}.}$$

Put in (1).

$$I_{out} = I_1 (1 - d)$$

$$I_{out} = 40.022 (1 - 0.69).$$

$$I_{out} = (40.022)(0.31)$$

$$\boxed{I_{out} = 12.406 \text{ A.}}$$

Scanned with CamScanner

COH5

Answer:

Buck-Boost Chopper:

=) It combines the concept of both step-up & step down.

=) The output voltage is either higher or lower than input voltage.

=) The output voltage polarity also be reservad.

=) The switch is either an SCR or GTO or IGBT.

=) when S is OFF, The source is disconnected.

=) with S = ON (TON), INON = V1*I1*Toff

=) with S = OFF (TOFF);

INOFF = V1 * I1 * TOFF.

=> Ignoring Loss:

$$\text{INON} = \text{INOFF} = V_1 * I_1 * T_{ON}$$

$$\Rightarrow V_1 * I_1 * T_{OFF}$$

$$\Rightarrow V_0 = V_1 \frac{dt}{(1-d)T} \Rightarrow V_1 \frac{d}{(1-d)}$$

$$I_L = \frac{I_{max} + I_{min}}{2}.$$

$$I_1 = I_L d = \frac{(I_{max} + I_{min})}{2} \times d$$

The averge and put

$$P_1 = V_1 I_1.$$

$$= \left(\frac{I_{max} + I_{min}}{2} \right)$$

$$\times dV \Rightarrow P_0 = \frac{V_0^2}{R}$$

$$I_{max} - I_{min} \Rightarrow \frac{V_i}{L} T_{ON}.$$

Again $I_{max} + I_{min} = 2 * I_1$.

Now

$$I_{max} = V_1 \left[\frac{1}{R(1-d)^2} + \frac{T_{ON}}{2L} \right]$$

$$I_{min} = V_1 \left[\frac{1}{R(1-d)^2} - \frac{T_{ON}}{2L} \right]$$

$$I_{P-P} = I_{max} - I_{min} = \frac{V_1 T_{ON}}{L}$$

For continuous current mode.

$$I_{min} = V_1 \left[\frac{1}{R(1-d)^2} - \frac{T_{ON}}{2L} \right]$$

$$\Rightarrow \frac{1}{R(1-d)^2} = \frac{T_{ON}}{2L}$$

$$L = \frac{R T_{ON}}{2} (1-d)^2$$