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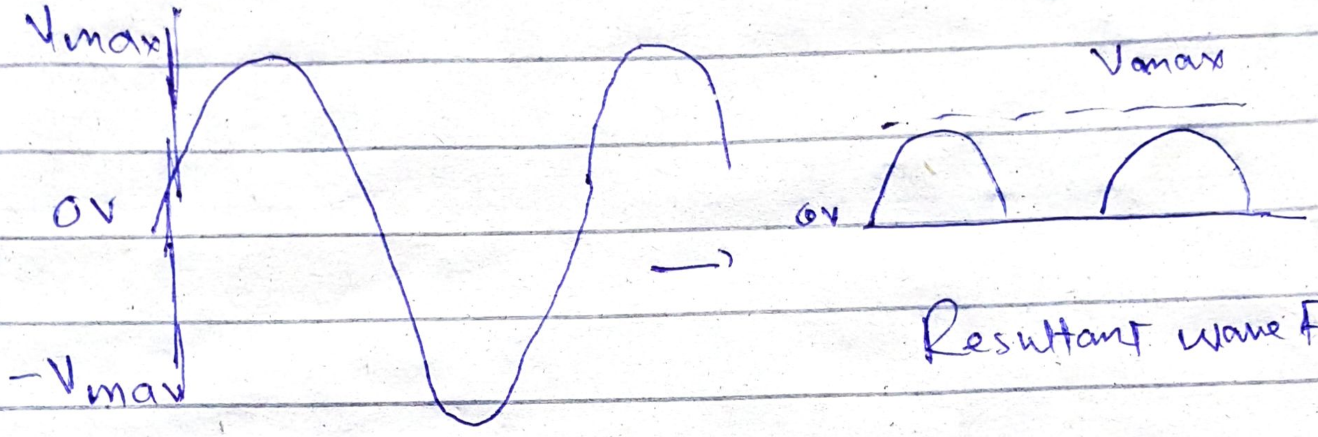
Differance b/w 1-ϕ half wave and Full wave bridge recifier

(1) Half wave recifier which convert only one half of the Ac cycle into pulsating DC while Full wave recifier is an electronic circuit which convert entire cycle Ac into Pulsating Dc.

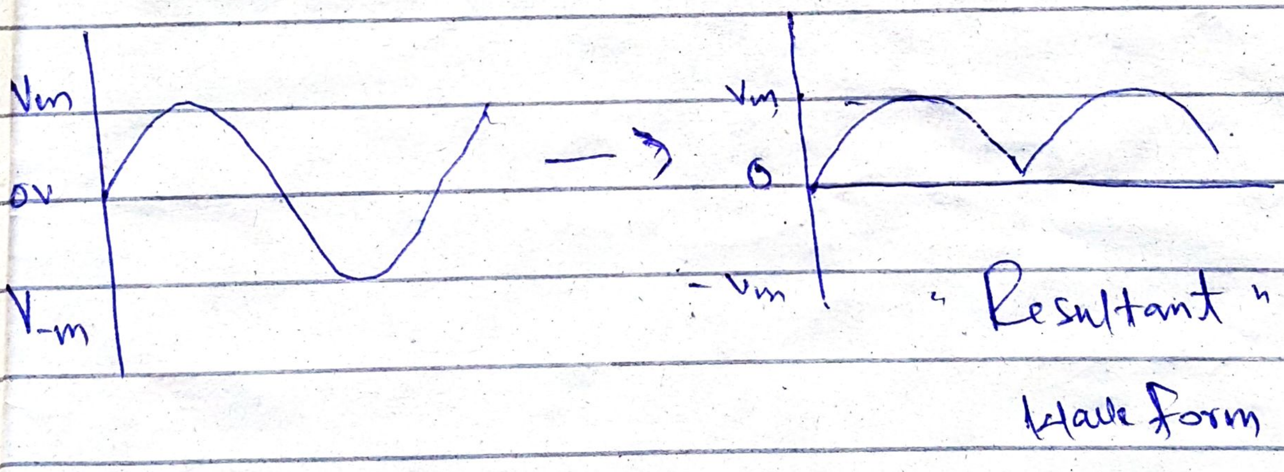
(2) Half wave utilize only half of the Ac cycle for the convertion while Full have utilize Full wave of the Ac cycle.

(3) Half wave is unidirectional, the conduction is one direction only either convert positive or negative, that why called Half wave recitifier while the Full wave recifier is bidirectional, it conduct for positive half as well as negative half of the cycle

(4) out put wave form of 1-Φ single phase half wave recifier



and single phase full wave bridge recifier



(5) The number of diode in half wave recifier is 1 while in bridge recifier is 4.

"Similarities b/w Single phase Half wave and Full wave Bridge recitifier"

① Peak inverse voltage of Single half wave and full wave recitifier are same which is Vm and same in both recifier

② Both utilize the single phase for the operation.

2) 1-ϕ Uncontroll and controll recitifier (difference and similarities)

① Uncontroll they are naturally turn on whenever a positive voltage is applied between its terminal and when you stop by applying it negative voltage while in controll recifier, the conduction start at any angle in positive half cycle namely 0 to 180 degree. Once the condiction start can be turn on and off.

Q.2
Solution

$V_m = 26V$
$R = 12\Omega$

We know that

For half wave
1) Vdc

$\Rightarrow \frac{V_m}{\pi}$ — ①

where $V_m = 26V$
$\pi = 3.14$

Put in equation ①

$\frac{26}{3.14} = 8.2V$

For Full wave bridge

$\frac{2V_m}{\pi}$ putting value

$\frac{2(26)}{3.14} \Rightarrow 16.5V$

② I_{dc}

For half walf

$I_{dc} = \frac{V_m}{\pi R}$

$\Rightarrow \frac{26}{(3.14)(13)} = 0.64A$

For Full wave

$I_{dc} = \frac{I_m}{\pi}$ where $I_m = \frac{V_m}{R}$

$\Rightarrow \frac{2}{3.14} \Rightarrow 0.6A$ $\Rightarrow \frac{26}{13} = 2A$

Put in above

③ V_{rms}

For half wave

$V_{rms} = \frac{V_m}{2}$

$\Rightarrow \frac{26}{2} = 13V$

$V_s = \frac{V_m}{\sqrt{2}}$

$\Rightarrow \frac{26}{\sqrt{2}}$

$\Rightarrow 18.4V$

For Full wave

$V_{rms} = \sqrt{2}\, V_s$

$V_{rm} = 26.02V.$

4) Irms

4) Irms for half wave and full wave bridge

For half wave

$$I_{rms} = \frac{V_m}{2R}$$

$$\Rightarrow \frac{26}{2(13)}$$

$$\Rightarrow 1A$$

For full wave

$$\Rightarrow \frac{I_m}{2} \quad \text{— * equation}$$

where $I_m = \frac{V_m}{R}$

$$\Rightarrow \frac{26}{13}$$

$$\Rightarrow 2A$$

Put in equation ★ we get

$$\boxed{\Rightarrow \cancel{2}/\cancel{2} = 1\,A}$$

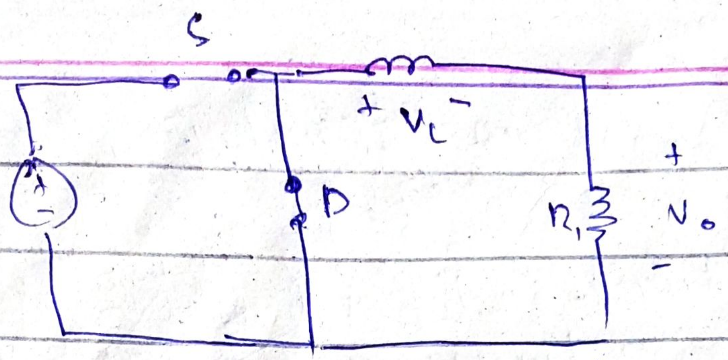
5

I would like to refer the uncontroll full wave bridge recifier because the efficiency of bridge recifier is better than the full wave bridge recifier is better than in half wave recitifier and output frequency also greater than half wave recifier.

Q.3)

Buck chopper

1) Output voltage is less than input voltage.
2) The thyristor in the circuit acts a switch
3) When thyristor is ON, supply voltage appear across the load.
4) When thyristor is OFF, The voltage across the load will be zero
5) Practical arrangement include an inductor L and diode which are used to eliminate current pulsation providing a smooth DC current.
6) With S closed, D is off and it remain off as long as S in ON
7) The i/p current build up exponentially and flow through L and load.
8) Vo equal V_1
9) With S off or open, the current through L decay to zero
10) This causes inductive voltage with opposite polarity across L.



(Circuit when Switch is opened)

Data:

$V_{in} = 50V$

$D = 26\%$

$R = 13\Omega$

Frequency $= 20kHz$

1) Vout

We know that

$V_{out} = \overset{\text{or } D}{\alpha} V_s$ — ① or $V_{out} = D \times V_s$

Here α = Duty cycle

Which $26\% = 0.26$

Put in equation ① we get

$\Rightarrow (0.26)(50)$

$\Rightarrow 13V$

2) Iout

$I_o = V_o / R$

$\Rightarrow 13/13$

$\Rightarrow 1\,A$

3) I_{in}

We know that

$$I_o = \frac{I_i}{\alpha \text{ or } D}$$

$I_i = I_o \times d$

where α duty cycle or d is duty cycle

$I_i = 1 \times 0.26$

$I_i = 0.26\,A$

4) Inductor

We know that

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

let suppose $T_{OFF} = 0.004$

$$L = \frac{0.004}{2} \times 13$$

$$L = 0.026\,H$$

Q.4)

Boost chopper

1) The output voltage is more than the input voltage by several time
2) L is used to provide smooth i/p current
3) The SCR (s) acts as the switch which work in the PWM mode
4) With S ON, the L is connected to the supply
5) Load voltage V_L jumps instantaneously to V_1, but current through L increase linearly and stored energy.
6) When S is open, the current collapses and energy stored in L is transferred to C through D.
7) The induced voltage across the inductor reverse and adds to the source voltage voltage increasing the O/P voltage.
8) The current that was flowing through S now flow through L, D and C to the load.

9) Energy stored in the inductor is released to the load.

10) When S closed again, D become reverse biased, the capacitor energy supplied the load voltage and cycle again

$$V_o = V_i + V_L$$

11) Vo is alway higher than V_1 as polarity of inductor voltage V_L is same as V_1

12) If inductor L is very large, source current I_1 is ripple free and considered constant.

$$[W_{ON} = V_1 I_i T_{ON}]$$

13) Assuming C to be large enough to neglect the voltage ripple, Vo is considered constant

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

14) Since losses are neglect, the energy stored transferred during T OFF by L must be equal to energy gained during T ON

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

$$V_o = V_1 \left(1 + \frac{T_{ON}}{T_{OFF}}\right) = V_1 \left(\frac{T}{T - ON}\right)$$

$$\Rightarrow V_i \left(\frac{1}{1 - \frac{T_{ON}}{T}}\right) = V_1 \left(\frac{1}{1-d}\right)$$

Thus V_o is alway greater than V_1

$\rightarrow P_1 = P_o \rightarrow V_1 I_1 = V_o^2/R \rightarrow I_1 = \frac{V_o^2}{V_1} * 1/R$

$\rightarrow I_o = I_1 \times \frac{T_{OFF}}{T} \Rightarrow I_o = I_1 (1-d)$

$\rightarrow P_o = P_1 \Rightarrow V_1 I_1 \Rightarrow V_o^2/R = \frac{V_i^2}{(1-d)^2} * 1/R$

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

$\rightarrow I_L = \frac{I_{Max} + I_{min}}{2} = I_1$

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

→ Voltage across L is

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

$$\Delta I_1 = \frac{V_1 \times T_{ON}}{L} \text{ or } I_{Max} - I_{min} \Rightarrow \frac{V_i \ T_{ON}}{L}.$$

Again $I_{max} + I_{min} = 2 \times I_1$

Solving

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

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

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

For continuous current mode

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

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

(Boost)

Data

$V_{in} = 50V$

duty cycle $D = 26\%$

Resistor, $R = 13\Omega$

Frequency, $F = 20kHz$

1) Vout

We know that

$$V_o = V_i \left(\frac{1}{1-d} \right)$$

$$V_o = 50 \left(\frac{1}{1-0.26} \right)$$

$$V_o = 50 \left(\frac{1}{0.74} \right)$$

$$V_o = 67.56V$$

2)

I_{out}

$I_o = I_1(1-d)$ —— (1)

First we have to find I_{in}

3) I_{in}

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

$$\Rightarrow \frac{50}{(1-.26)^2} \times \frac{1}{13}$$

$$\Rightarrow \frac{50}{0.5476} \times \frac{1}{13}$$

$$\Rightarrow \frac{50}{7.1188}$$

$\Rightarrow 7.0A$ Put this value equation (1)

$I_o = I_i(1-d)$

$I_o = 7(1-0.26)$

$I_o = 7(0.74)$

$\boxed{I_o = 5.18\,A}$

4) Inductor

$L = \frac{R T_{ON}}{2}(1-d)^2$ — 1

$d = \frac{T_{ON}}{T}$

$T = \frac{1}{20\times1000}$

$T = 20000$

$T_{ON} = d \times T$ **ON Next page**

~~$T_{ON} = 0.26 \times 20000$~~ (0.00005)

~~$T_{ON} = 5200$ put in equation~~ 1

~~$L = \frac{13 \times 5200}{2}(1-0.26)^2$~~

~~$L = \frac{13 \times 5200}{2}(0.5476)$~~

$T_{ON} = 0.26 \times 0.00005$

$T_{ON} = 0.000013$ (put in equation 1)

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

$$L = \frac{13(0.000013)}{2}(1-0.26)^2$$

$L = 0.000046H$

Q.5

Buck-Boost chopper:

→ It Combines the concept of both step-up and step-down choppers
→ The output voltage is either higher or lower than input voltage
→ The output voltage polarity also be reserved.
→ The Switch is either an SCR or GTO or IGBT
→ When S in ON, D is reverse bias and I_D is zero
→ While S is OFF, the Source is disconnected
→ The current through inductor does not change instantanously and it forward biases the diode, providing path for the load
→ with S = ON (T_{ON}); $W_{ON} = V_1 * I_1 * T_{ON}$
with S = OFF (T_{OFF}); $W_{ON} = V_1 * I_1 * T_{OFF}$
→ Ignoring losses, $W_{ON} = W_{OFF} \Rightarrow V_1 * I_1 * T_{ON}$

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

→ $V_0 = V_1 \dfrac{dT}{(1-d)T} = V_1 \dfrac{d}{(1-d)}$

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

$\times d$

in V

The average output $P_1 = V_1 I_1 = \left(\frac{I_{max} + I_{min}}{2}\right)$

$\times dV \Rightarrow P_o = \frac{V_o^2}{R}$

$\rightarrow I_{max} + I_{min} = \frac{2dV_1}{R(1-d)^2}$; $I_{max} - I_{min} = \frac{V_1}{L} dT$

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

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

For continuous current condition

$I_{min} > 0 = V_1 \left[\frac{1}{R(1-d)^2} - \frac{T}{2L}\right] d$

$\Rightarrow L = \frac{RTd(1-d)^2}{2}$

Data)

$V_{in} = 50V$

$V_{out} = \cancel{12\%}\ 26\%$

Resistor, $R = 13\,\Omega$

Frequency, $f = 20KHz$

1) Duty cycle (D) we know that

$$\frac{V_o}{V_1} = -\frac{D}{1-D}$$

$$V_o = +V_i \frac{d}{(1-d)}$$

$$0.26 = +50 \frac{d}{1-d}$$

$$(0.26)(1-d) = 50d$$

$$0.26 - 0.26d = 50d$$

$$0.26 = 50d + 0.26d$$

$$0.26 = 50.26d$$

PTO

$$\frac{0.26}{50.26} = \frac{\cancel{50.26}\,d}{\cancel{50.26}}$$

$$d = 0.0051$$

2) **I_{out}**

We know that

$$I_{max} + I_{min} = \frac{2dV_i}{R(1-d)^2}$$

$$I_{max} + I_{min} = \frac{2(0.0051)(50)}{13(1-0.0051)^2}$$

$$\Rightarrow \frac{0.51}{12.9}$$

$$\Rightarrow 0.039 \quad \text{— } (1)$$

We know that

$$I_{out} = \frac{I_{max} + I_{min}}{2}$$ Put equat (1) value

$$\Rightarrow \frac{0.039}{2} \Rightarrow 0.0195A$$

3) $I_i = ?$

$I_i = I_L d$

$\Rightarrow 0.0195 \times 0.0051$

~~⇒ 0.000099~~

$\Rightarrow 0.000099 A$

4) Inductor

$$L = \frac{RTd}{2}(1-d)^2$$

Putting value where $T = \frac{1}{F}$

$$L = \frac{13(0.00005}{2}(1-0.0051)^2$$

$T = \frac{1}{20 \times 1000}$

$T = 0.00005$

$$L = \frac{13(0.00005)}{2}(0.98)$$

$$\boxed{L = 0.00031 H}$$