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SUBBject → Power Electronics

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D/P → Electrical.

QNO 1:-

Uncontrolled Half wave Rectifiers-

(1) The rectifier element connected to the line at the highest +ve instantaneous voltage can only conduct and pulsates b/w Vmax and 0.5 Vmax.

(2) It is called 3-Φ 3 pulse rectifier as the o/p is repeated thrice in every cycle of V_s.

(3) The ripple frequency (F_r) of the o/p voltage is " $F_r = nF_s$ " n = no of diodes F_s = AC supplies Freq

(4) The ON diode connects its most +ve source terminal to the other two diode cathodes keeping the other diodes off

(5) The sudden switchover from one diode to another is called commutation.

(6) Each diode conducts for 120° intervals.

(2)

Full Wave Bridge Rectifier:-

(1) On the positive half cycle of transformer Secondry supply voltages diod, D_1 and D_2 conduct supply this voltage to the load.

(2) On the negative half cycle of supply voltages, diodes D_3 and D_4 conduct suppling this voltage to the load.

(3) It can be seems from the waveforms that the peak inverse voltage of the diode is only V_m.

(4) The average output voltage is the same as that for the centre trapped transformer full wave rectifier.

(5) Peak repetitive current diode = V_m/R

(6) Av. output voltage $V_0 = \frac{2V_m}{\pi}$, ~~RMS~~
RMS output voltage = $\sqrt{2}V_s$.

(2) Uncontrolled Rectifier:-

(i) Higher o/p voltage for given i/p voltages.

(ii) Lower amplitude ripples i-e output voltage is smoother.

(iii) Higher frequency ripples simplifying filtering.

(4) Higher overall efficiency.

Control Rectifiers:-

(i) Unlike diode, an SCR does not become conducting immediately after its voltage has become positive.

(ii) It requires triggering by means of pulse at gate.

(iii) So it is possible to make the thyristor conduct at any point on the half wave which applies positive voltage to its node.

Q2:

Given data:

$V_m = 42\,v$
$R = 13\,\Omega$

Required

Half wave
(i) V_{dc}
(ii) I_{dc}
(iii) I_{rms}
(iv) V_{rms}

Full wave Bridge
(i) V_{dc}
(ii) I_{dc}
(ii) I_{rms}
(iv) V_{rms}.

Solution:-
We know that,

V_{dc} For Half wave is

$V_{dc} = V_m/\pi$
$V_{dc} = 42/3.14$

$V_{dc} = 13.37v$

ii) $I_{dc} = V_m / \pi R$

$I_{dc} = 42 / 3.14 \times 13$

$I_{dc} = 42 / 40.82$

$I_{dc} = 1.02$ Amp

iii) $I_{rms} = V_m / 2R$

$I_{rms} = 42 / 2 \times 13 = \frac{4}{26}$

$I_{rms} = 0.153$ A

iv) $V_{rms} = V_m / 2$

$V_{rms} = 42/2$

$V_{rms} = 21$ V

→ Now for Full wave bridge

i) $V_{dc} = 2V_m / \pi$

$V_{dc} = 2(42)/3.14 = 26.75$

$V_{dc} = 26.75$ V

(ii) $Idc = Vm/R$

$Idc = 42/13$

$Idc = 3.23\ A$

(iii) $Irms = Idc/2$

$Irms = 3.23/2$

$Irms = 1.615\ A$

(iv) $V_{RMS} = \sqrt{2}\,Vs$

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

$V_{Rms} = 1.41 \times 26.75$

$V_{RMS} = 37.7175\ V$

Full wave rectifier is better then half wave because it allows both positive and negative cycle But in half wave it block negative and just allow the positive to move.

Q3

Answer

Buck chopper Application

When Switch is open:-

When switch is open the inductor stores energy in the form of a magnetic field. If the switch is opened while the current is still changing, then there will always be a voltage drop across the inductor, so the net voltage at the bad load will always be less than the input voltage source

When Switch is closed:-

When the Switch is ~~not~~ closed the current will begin to increase and the inductor will produce an opposing voltage across its terminals in response to the changing current. This voltage drop counteracts the voltage of the source and therefore reduces the net voltage across the load.

Working of buck chopper :-

The buck converter circuit consists of the switching transistor, together with the flywheel circuit (D1, L1 and C1)

while the transistor is on current is flowing through the load via the inductor L1. The action of any inductor opposes changes in current flow and also acts as a store of energy.

Numerical:-

Given data:

Vin = 50V

D = 42%

R = 13

F = 20KHZ

Required

Vout, Iout, Iin, inductor = ?

(i) $V_{out} = ?$

We know that:

$V_o = d(V_i)$

$= (0.42 \times 50)$

$V_o = 21\ V$

(ii) $I_{out} = ?$

$I_{out} = V_o/R$

$I_{out} = 21/13$

$I_{out} = 1.615\ A$

(iii) $I_{in} = ?$

$I_{in} = V_i/R$

$I_{in} = 50/13$

$I_{in} = 3.84\ A$

(iv) Inductor $(L) = ?$

$L = \frac{T_{OFF}}{2} \times R \longrightarrow (A)$

So we have

$V_o = dV_i$

$d = V_o/V_i$

$d = 21/50$

$d = 0.42$

now

$$\frac{T_{ON}}{T} = 0.42 \rightarrow (B)$$

$$T_{ON} = 0.42 \times T$$

Note: $T = 1/F$

$$T_{ON} = 0.42 \times \frac{1}{F}$$

$$T_{ON} = \frac{0.42}{F}$$

$$T_{ON} = \frac{0.42}{20{,}000}$$

$$\boxed{T_{ON} = 0.00021\,s}$$

put in (B) we get,

$$\frac{T_{ON}}{T} = 0.42$$

$$T = \frac{0.00021}{0.42}$$

$$\boxed{T = 0.0005\,s}$$

Now $T = T_{ON} + T_{OFF}$

$$T_{OFF} = T - T_{ON}$$

$$= 0.0005 - 0.00021$$

$$\boxed{T_{OFF} = 0.00029\,s}$$

Now put this in eq (A)

we get

$$L = \frac{0.00029}{2} \times 13$$

$L = 0.001885\ H$

OR

$L = 18.85\ mH$ Ans

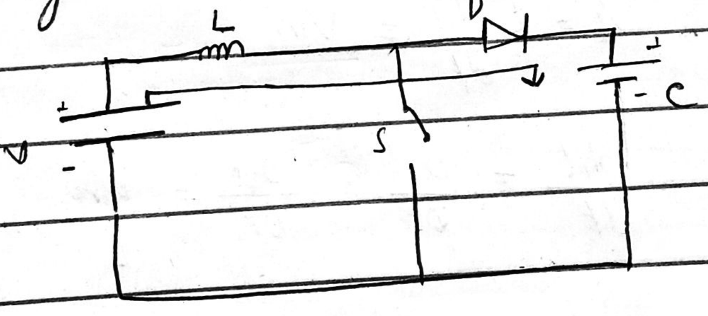
Q4:

Answer 2

Working Principle:-

The main working principle of boost converter is that the inductor in the input circuit resists sudden variations in input current.

When switch is OFF the inductor stores energy in the form of magnetic energy & discharges it when switch is closed. The capacitor in the output circuit is assumed large enough that the time constant of RC circuit in the output stage is high.



The output capacitor is charged to the input voltage - one diode drop.

When SW is ON. our Signal source goes high, turning on MOSFET. All the current is directed through do the Mosfet through the Inductor. The output capacitor stays charged since it can't discharge through the now back-biased diode. is ON for a time t_{ON} & is OFF for time T_{OFF}. We define the time period, T as $T = T_{ON} + T_{OFF}$ & the switching frequency

$$f_{switch} = 1/T$$

now define another term duty cycle

$$D = T_{ON}/T$$

Boost converter in steady state equation for this mode using KVL.

$$V_{in} = V_l$$

$$V_l = L\frac{di_l}{dt} = V_{in}$$

$$\frac{di_l}{dt} = \frac{\Delta i_l}{\Delta t} = \frac{\Delta i_l}{DT} = \frac{V_{in}}{L}$$

Since the switch is closed for a time $T_{ON} = DT$ we can say that $\Delta t = DT$.

$$(\Delta i_l) = \left(\frac{V_{in}}{L}\right) DT$$

Numerical part:-

Given data:

$V_{in} = 50\ V$

$D = 42\% = 0.42$

$R = 13$

$F = 20\ KHZ$

Required

V_{out}, I_{out}, I_{in}, inductor = ?

Solution:-

As we know that,

(i) $V_{out} = \frac{V_s}{1-D}$

$V_{out} = \frac{50}{1-0.42}$

$\boxed{V_{out} = 86.20\ V}$

(ii) $I_{out} = ?$

$I_{out} = \frac{V_{out}}{R} = \frac{86.20}{13}$

$I_{out} = 6.630A$

(iii) $I_{IN} = \frac{I_{out}}{1-D} =$

$I_{in} = \frac{6.630}{1-0.42}$

$I_{in} = 11.43\,A$

Q5:-

Definition:

Buck Boost Converter:-

The buck boost converter is a type of DC-DC that has output voltage magnitude that is either greater than or less than input voltage magnitude it is equal to fly back converter using a sigle inductor instead of a transformer.

Principles and working of Buck Boost converter:

The main working principle of buck Boost converter is that the induce in the input circuit result suddin variations in input current. When switch is ON the inductor store energy in the form of magnitude energy and discharged it when sw is closed the capacitor in the output circuit is assummed large is enough that the time constant of RC circuit in the output stage is high the large time constant compare to switching period ensure a constant output voltage

$V_o(t) = V_o$ (constant).

Numerical:-

$V_{in} = 50\ V$

$V_{out} = 42\% = 0.42$

$R = 13\ \Omega$

$f = 20\ KHZ$

Find ① Duty cycle, Iout, Vin, inductor = ?

Solution,

We can't find the duty cycle because the time is not given so the duty cycle is zero.

(ii) $I_{out} = V_{out}/R$

$I_{out} = \frac{0.47\Omega}{13}$

$I_{out} = 0.032\ A$

(iii) $V_{in} = 50\,v$

(iv) Inductor (L)?

we also can't find Inductor because the time is not given.