ID = 13132   subject = power electronic

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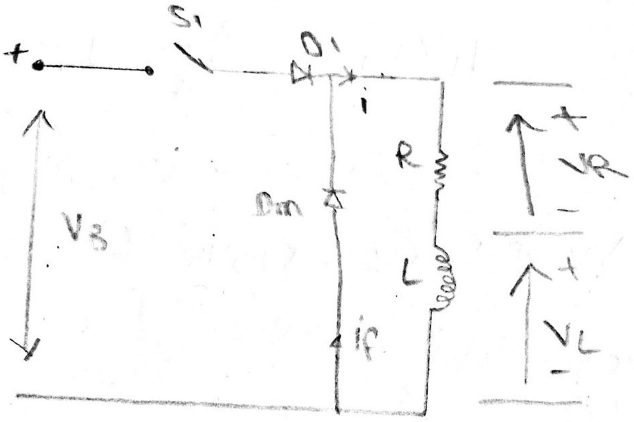
Q1 (a)

Ans A diode circuit with an RL load



when switch S_1 is closed at $t=0$ the current through the inductor increase and is expressed as

$$V_s = V_L + V_R = L\frac{di}{dt} + Ri$$

with the initial $i(t=0)=0$ $i(t)$ is expressed

$$i(t) = \frac{V_s}{R}\left(1-e^{-tR/L}\right)$$

The rate of change of this current can be obtained from

$$\frac{di}{dt} = \frac{V_s}{L}e^{-tR/L}$$

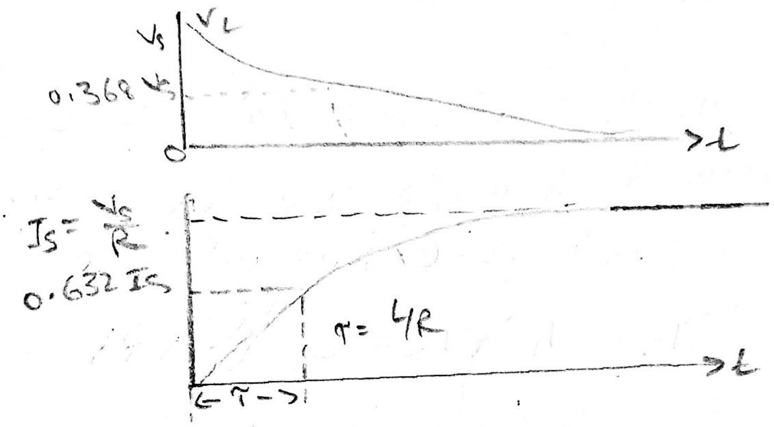
the initial rate of rise of the current (at $t=0$) is obtained

$$\left.\frac{di}{dt}\right|_{t=0} = \frac{V_s}{L}$$

The voltege across the inductor is

$$V_L(t) = L\frac{di}{dt} = V_s e^{-tR/L}$$

wher $L/R = \tau$ is the time constent of an RL load. The wave forms for the voltege and current



Free Wheling Diode.

-> A free wheling diode is basically a diode connected across the inductive load terminals to prevent the develpment of high voltege across the switch.

-> When the inductive circuit is switched off this diode gives a short circuit path for the flow of inductor decay current and hence dissipation of stored energy in the inductor.

-> This diode is also called flywheel or fly back diode.

Q1 (b) Given

$V_{DS} = 32V$

$V_T = 2V$

Find:

$V_{GS} = ?$

Sol.

As we know that.

where for saturation

$V_{DS} \geq V_{GS} - V_T$

$V_{DS} = V_{GS} - V_T$

Where

$V_{GS} = V_{DS} + V_T$

putting value we get

$V_{GS} = 32 + 2$

$\{V_{GS} = 34V\}$ Ans.

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Q2 (a) A power electronic appliance of 500W 220V, 50 KHZ rating is using a power mosfet for switching purpose The power mosfet is replaced with power biopolar junction transistor. its effect on his performance and losses and efficiency on the appliance. The switching frequency will be lower of appliance because mosfet have high switching frequency the Bio polar junction transistor.
The losses will be low because losses in BJT is less than Mosfet have high switching frequency than BJT loss in appliance will be low another reason losses.
The BJT cannot operate at high frequency one of the impact on performance 500KHZ. on state voltage low for BJT so the frequency of the impact on performance the appliance improve.
The switching losses will increase.

due to Bjt in appliance.
But conduction losses will be decrease because of Bjt replacement in appliance.
on the high frequency Bjt are less efficent that also effect on its performance.
The frequency of appliance is high and Bjt have low frequency rate and switching frequency need to adjust frequency because is so high.

Q2 (B) The above appliance are if the mosfet replaced with SCR as switch and impact its performance losses and efficency is given.
The SCR have no capabilities to handle high frequencies and will impact on its performance
The SCR can handle more power voltage current which increase the efficency of the appliance and one of the advantages efficiency.

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The SCR can protected because of the fuse which can decrease losses used as the performance of the appliance improve.

Q3 (a) Given

B_F range 8 to 40

$R_C = 32\,\Omega$

$V_{CC} = 132V$

$V_B = 10V$

$V_{CE} = 1V$

$V_{BE} = 1.5V$

Find

(a) The mode of operation of the transistor

(b) the value of R_B that results in saturation with an ODF of 5

(c) the B forced

(d) the power loss P_T in the transistor.

Sol

As we know that

$$I_{CS} = \frac{V_{CC} - V_{CE(sat)}}{R_C}$$

$$= \frac{132 - 1}{32}$$

$$I_{CS} = 4.0\,A$$

There fore

$$I_{BS} = \frac{I_{CS}}{B_{min}}$$

$= \frac{4.0\,A}{8}$

$I_{BS} = 0.5A$

$I_B = ODF \times I_B$

$= 5 \times 0.5$

$I_B = 2.5A$

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

Therefore

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

$= \frac{10V - 1.5V}{2.5}$

$\{R_B = 3.4\Omega.\}$

B) Therefore

$B_f = \frac{I_{CS}}{I_B}$

$= \frac{4.0}{2.5}$

$\{B_f = 1.6\}$

c) $P_T = V_{BE} I_B + V_{CE} I_C$

$P_T = 1.5 \times 2.5 + 1 \times 4.0$

$= 3.75 + 4$

$\{P_T = 7.75W\}$