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Subject : Power Electronics.

Assign. : Paper mid.

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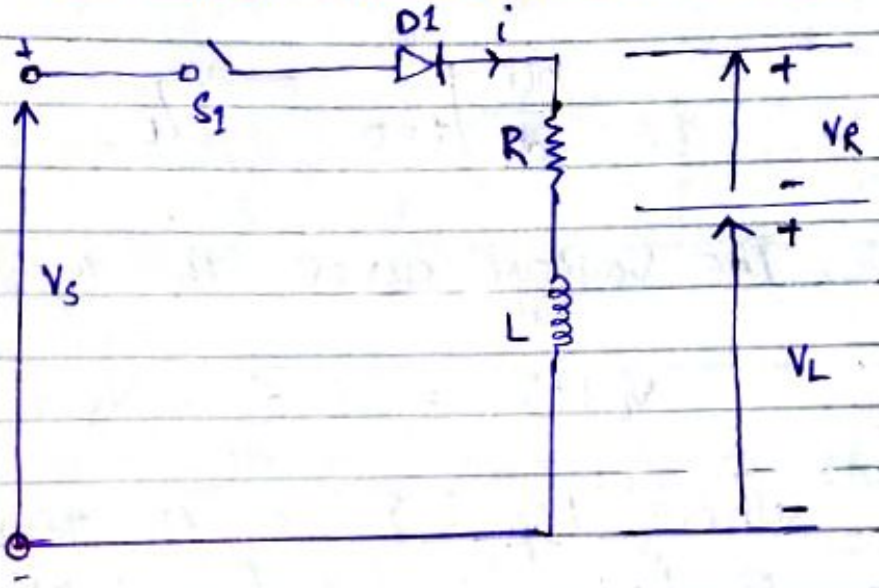
Power Electronics

Assignment

(Q 1 (a))

Answer:

=> R-L Connected in series with Diode:



when S1 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 condition $i(t=0) = 0$
$i(t)$ is expressed as.

$$i(t) = V_S/V_R\,(1 - e^{-tR/L})$$

=> The rate of change of the current can be obtained from.

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

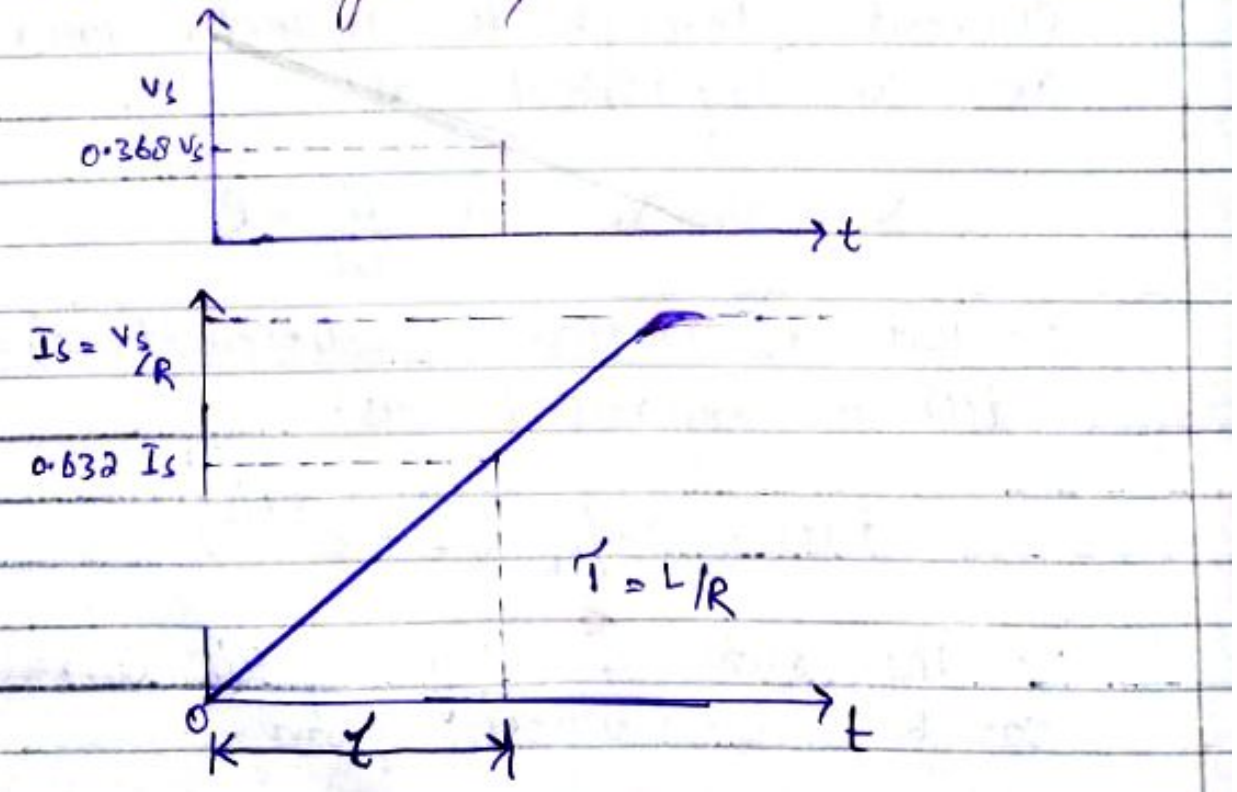
⇒ The initial rate of rise of the current (at $t=0$) is obtained:

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

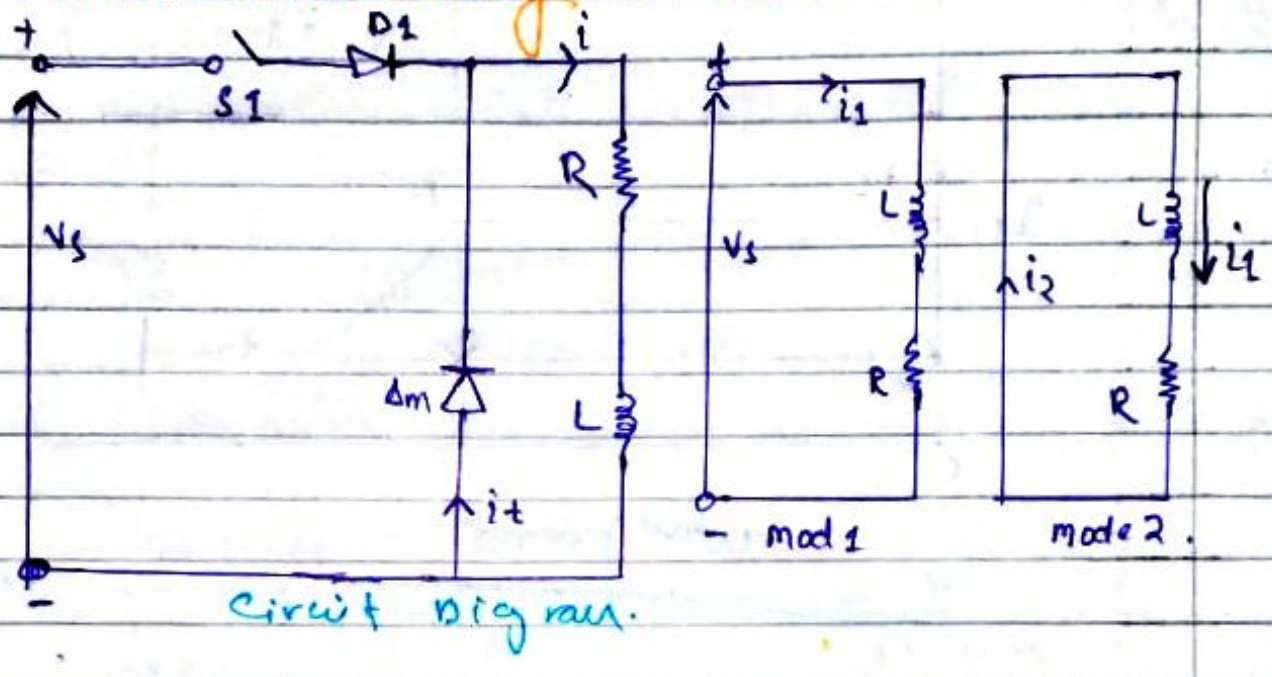
The voltage across the inductor is

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

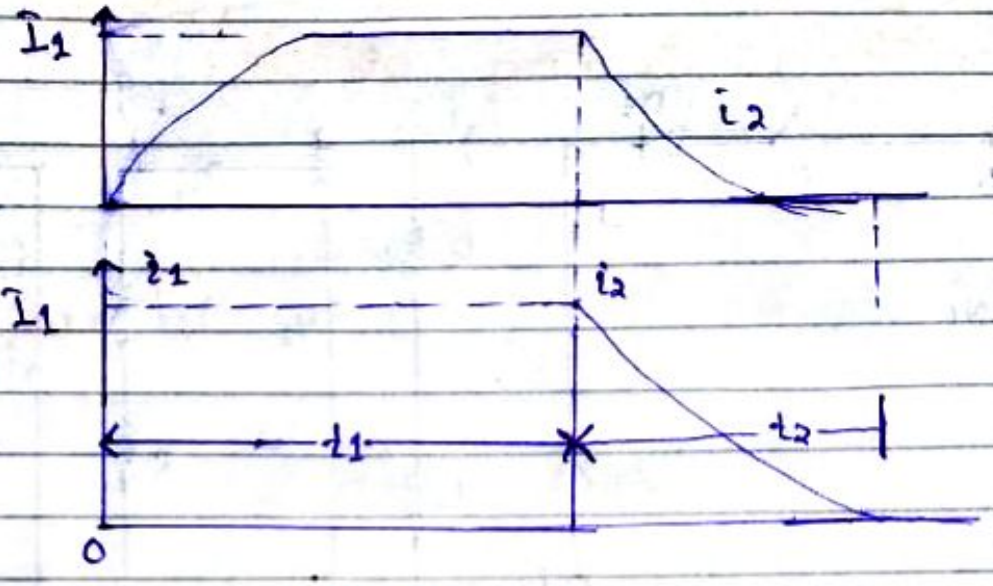
where $L/R = \tau$ is the time constant of RL circuit. The waveforms for the voltage & current are shown.



∴ R-L circuit connected in parallel with wheeling diode:



=> The inductor has property to store energy.
=> In AC current during positive high cycle the inductor store energy.
-> At negative half cycle the inductor de-energies.
-> This may cause reverse damage to circuit.
-> To avoid energy description free wheeling diode is becomes forward bias so the current will flow through diode.



wave form

Q1 (b)

Solution:

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$V_{DS} = 69\ V.$

$V_T = 9\ V.$

for solution.

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

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

$\Rightarrow V_{GS} = V_{DS} + V_T.$

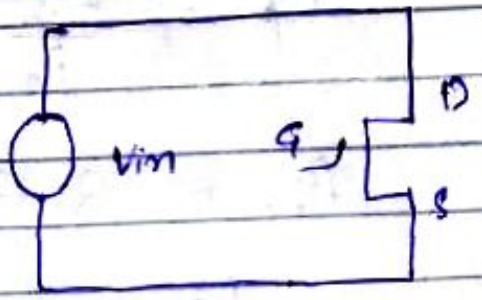
$V_{GS} = 69 + 9.$

$69 + 9 = 78$

$\boxed{V_{GS} = 78\ V}$

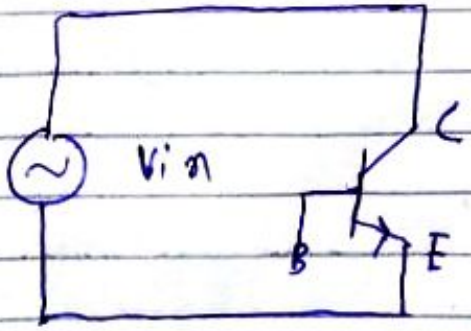
Q#2 (a)

Answer.



whenever power MOSFET is connected to the power electronics circuit, it has high switching, high efficiency & less losses.

=> when power MOSFET is replaced by power bipolar junction transistor, so, its switching speed decreases, efficiency decreases & its loses increases, as power bipolar junction transistor is mainly use for amplification

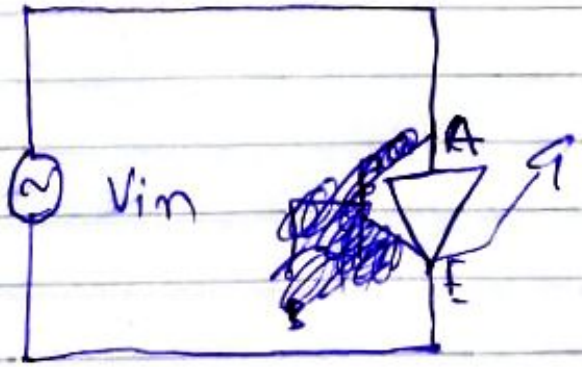


Q#2 (b)

Answer

When power bipolar junction transistor is replaced by silicon controlled rectifier. So, an output we get controlled output voltage & switching.

=> In case of silicon controlled rectifier we get fast switching then power BJT but less their power rating, variable efficiency & less losses.



X ——— X ——— X

Q#3 (a) Numerical:

Given data:

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$R_C = 69\ \Omega$.

$V_{CC} = 109$ V.

$V_B = 10$ V.

$V_{CE(sat)} = 1$ V.

&

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

To find:

a) mode of operation transistor.
b) R_B
c) β_{forced}
d) power loss P_T.

Solution:

a). mode of operation transistor is.

saturated mode.

(b)

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

$$I_{CS} = 10 - \frac{9}{4} / 4.$$

$$I_{CS} = 2.43\ A. \quad \leftarrow$$

$$\because \quad I_{BS} = I_{CS} / \beta_{min.} \Rightarrow \frac{2.43}{8.}$$

$$I_{BS} = 0.30\ A. \quad \leftarrow$$

$$\because \quad I_B = ODF \times I_{BS}.$$

$$I_B = 5 \times 0.30.$$

$$I_B = 1.5\ A. \quad \leftarrow$$

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

$$\Rightarrow R_B = \frac{V_B - V_{BE(sat)}}{I_B} \Rightarrow \frac{10 - 1.5}{1.5}.$$

$$\boxed{R_B = 5.66\ \Omega.}$$

(c) β forced.

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

$$\beta_f = 2.43 / 1.5$$

$$\boxed{\beta_f = 1.62}$$

(d) P_T

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

$$P_T = (1.5)(1.5) + 1(2.43)$$

$$P_T = 2.25 + 2.43$$

$$\boxed{P_T = 4.68\ W}$$

× —— × —— ×

THE END.