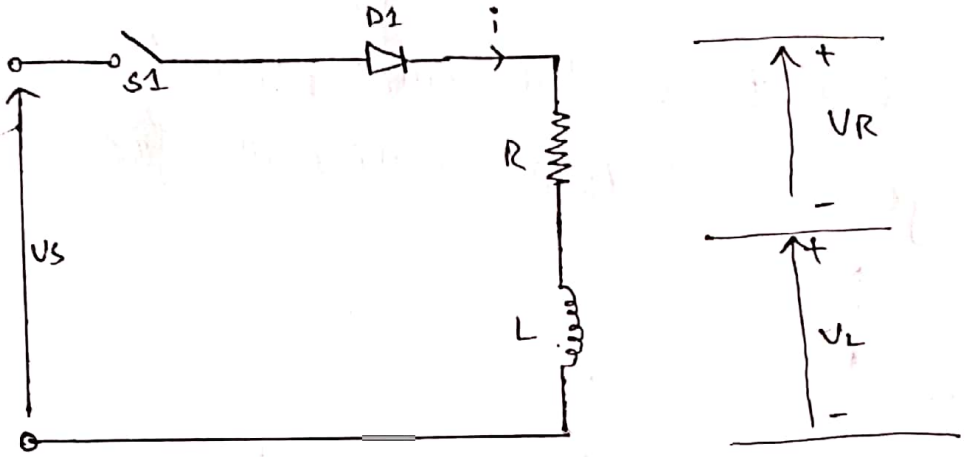
(ASAD SHOAIB KHALIL) (ID# 13095) (Power Electronics)

Question # 1

Part (a)

Answer:-

⇒ R-L connected in series with Diode:-



*) When we closed S1 then t=0, the current through the inductor will increase. It will expressed as.

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

*) When the initial condition $i = 0$

$i(t)$ is

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

*) In the change of rate of circuit are

$$\frac{di}{dt} = \frac{V_s}{L}\,e^{-t\,R/L}$$

Scanned with CamScanner

* The inital rate of rise of the current is (t=0)

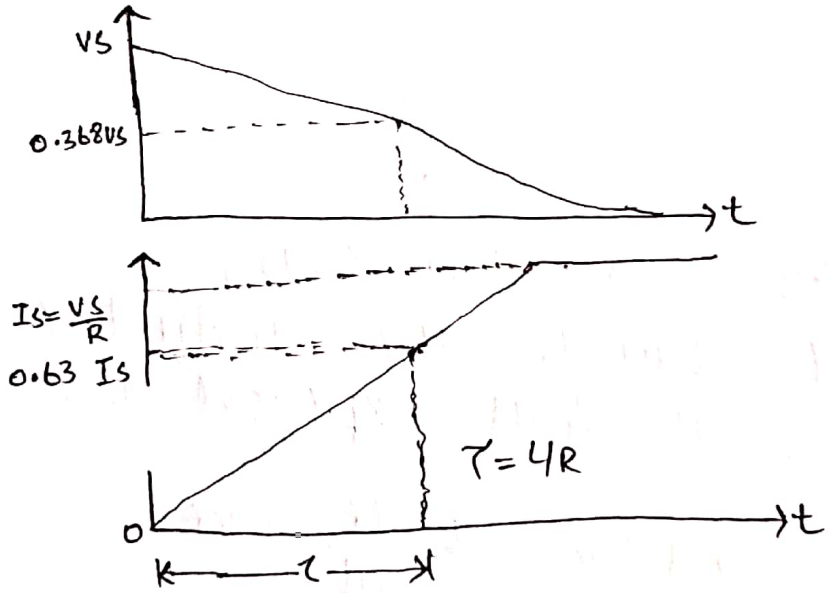
$$\left.\frac{di}{dt}\right|_{t=0} = \frac{V_S}{L}$$

Then the voltage across the inductor is

$$V_L(t) = L\frac{di}{dt} = V_S e^{-t\,R/L}$$

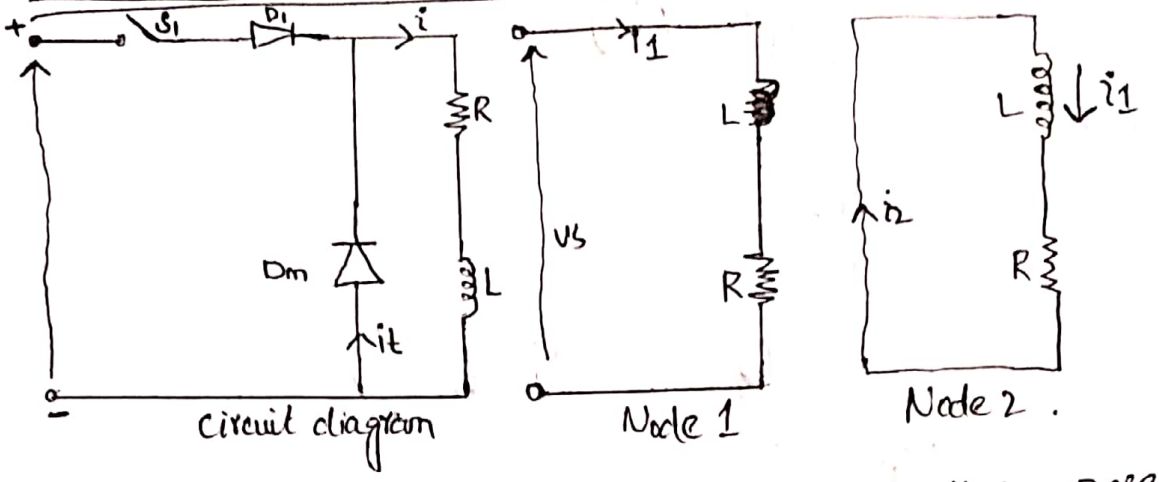
Where $L/R = t$ is the time constant of R_L load.

Voltage & current waveforms are.



Scanned with CamScanner

(*) RL Circuit connected in Parallel with wheeling diode :-



→ The Inductor has the ability to store energy.

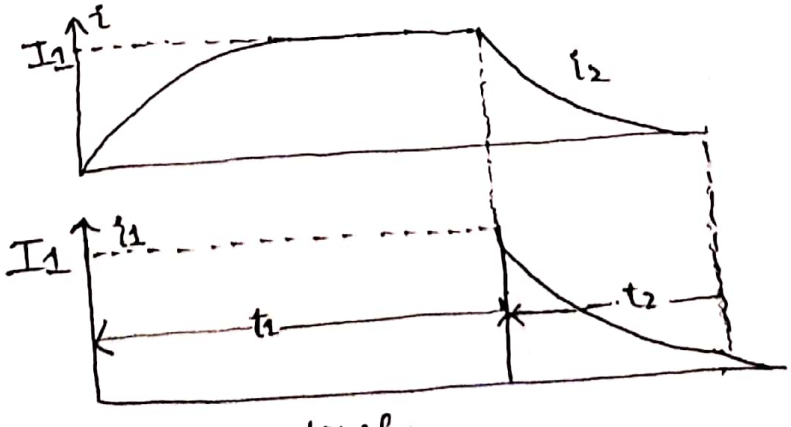
→ In AC current during positive high cycle the Inductor closes energy.

→ At negative half cycle the inductor de-energies

→ This may cause reverse damage to circuit.

→ To avoid energy descipation free wheeling diode is used.

→ In negative half cycle the free wheeling diode becomes forward bias so the current will flow through diode.



Scanned with CamScanner

Question 1
Part (b)

Answer:-

Data:-

$V_{DS} = 95V$

$V_T = 5$

for satution:-

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

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

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

$V_{GS} = 95 + 5$

$V_{GS} = 100V$

Scanned with CamScanner

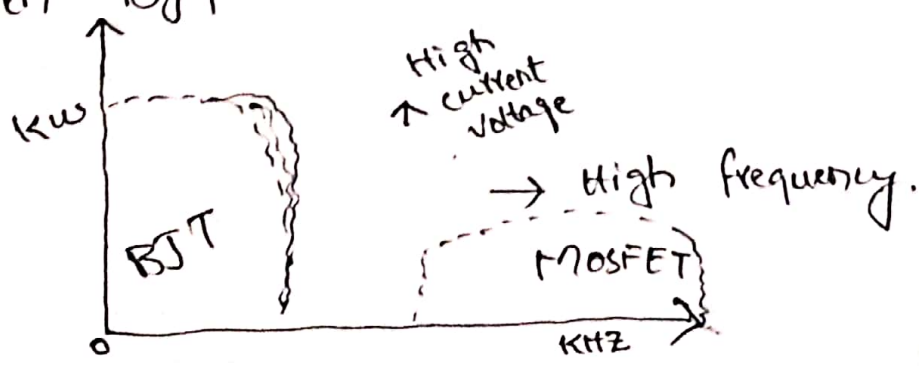
Question # 2
Part (a)

Efficient:- Mosfet is usually more efficient switches for power supplies. BJT will consume more power because it wasting current when it switch ON. Also the BJT generally has a 0.3V voltage drop in the Input pin & it takes a lot of base current to do that.

Mosfet is more Tolerant to heat and it can simulate a good resistor - MOSFET is used for Power supplies and is efficient whereas. BJT is used in low power consuming devices like LED - BJT consumes more Power as it is a current controlled devices.

LOSSES:- Losses due to BJT will be low & due to MOSFET will be higher because mosfet is voltage controlled device & BJT is current control

Switching of MOSFET is higher then BJT



Scanned with CamScanner

Performance :- In the performance of MOSFET is far best than BJT in higher power applications:

→ So overall if we replaced BJT by MOSFETS the performance & efficiency of the system will be best & little bit increase the losses.

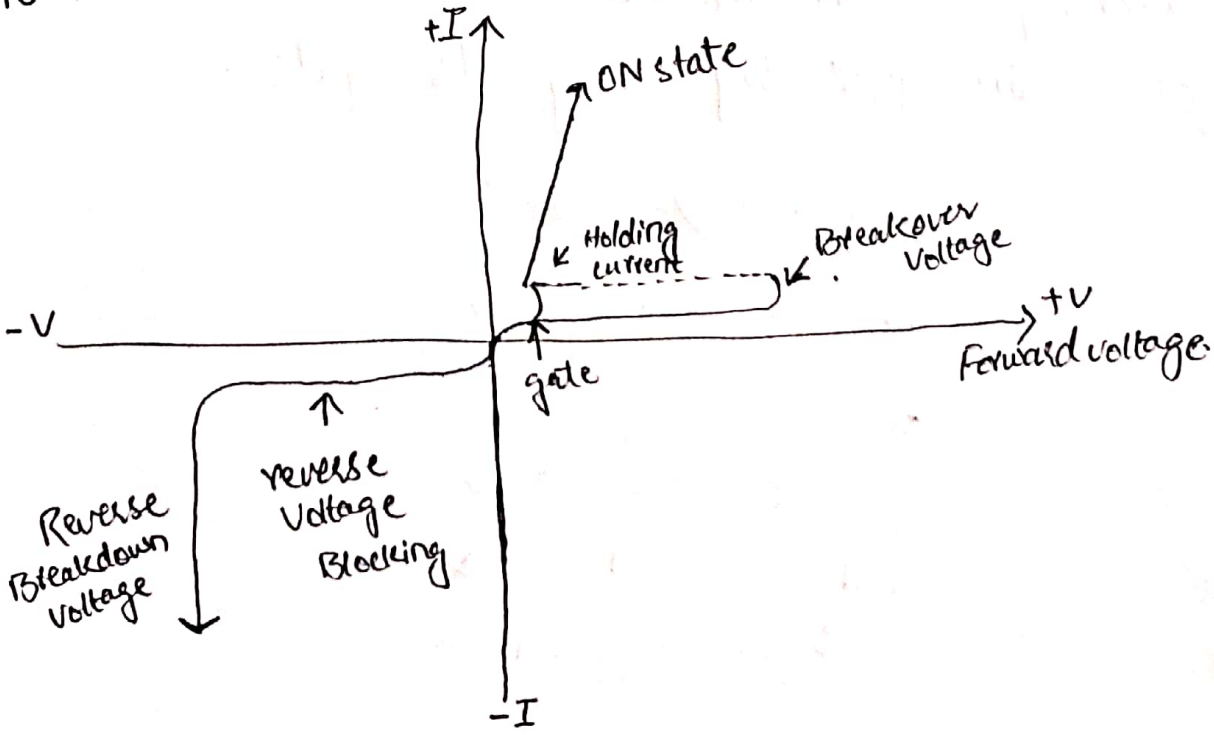
Scanned with CamScanner

Question #2

Part (b)

Answer:- If the power Mosfet is replaced with a silicon controlled Rectifier as, Silicon controlled Rectifier are unidirectional devices i-e can conduct current only in on direction, as opposed to which are bidirectional i-e charges carriers can flow through them in either direction. A SCR can be triggered normally only by current going into the gates as opposed to which can be triggered normally by either a positive or a negative current applied to its gate electrode.

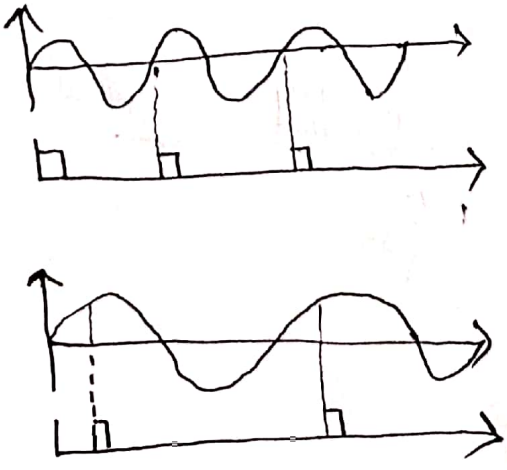
- It is multi-layer semiconductor device, hence the silicon part of its name. It requires a signal gate to turn it ON.



Scanned with CamScanner

Losses :-

ONce the thyristor has been turn "ON" and is passing current in the forward direction the gate signal losses all control due to the regenerative latching action of the two internal transistors. The application of any gate signals or pulses after regeneration is initiated have no affect at all because the thyristor is already conducting and fully ON. Therefore the thyrastor can also be thought of as a Bistable latch having two stable states "OFF" or "ON". This is because with no gate signal applied, a silicon controlled rectifier blocks current in both direction of an AC waveform, and once it is trigged into conduction. the regenerative latching action means that it can not be turned OFF again just by using its gate.



Gate Trigger Pulse.

Scanned with CamScanner

Performance:-

At this point, pulsing is discontinued until the 50% value on the second half of the wave is present, where the gate will be once again pulse reaches the zero line. No logic or conduction is performed on the negative direction wave only on the positive direction wave. To control both wave on an AC sine wave/circuit a device called a Triac is used. It basically is like two SCR is connected together, one forward & one backward with both gates connected together. Although it resembles & functions similar to two SCR is connected together. it is more involved in this.

Scanned with CamScanner

Question # 3.
Answer:-

* Given Data:-

$R_C = 95\,\Omega$
$V_{CC} = 095\ V$
$V_B = 10\ V$
$V_{CE} = 1$
$V_{BE} = 1.5\ V$

$B_{min} = 8$
$B_{max} = 40$

* Solution:-

(a) Saturated Mode

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

$= \dfrac{095 - 1}{95}$

$\boxed{I_{CS} = 94.9\ A}$

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

$= \dfrac{94.9}{8}$

$\boxed{I_{BS} = 11.8\ A}$

$CDF = \dfrac{I_B}{I_{BS}}$

$I_B = CDF \times I_{BS}$
$= 5 \times 11.8$

$\boxed{I_B = 59\ A}$

$R_B = \dfrac{V_B - V_{BE}}{I_B}$

$= \dfrac{10 - 1.5}{5.8}$

$\boxed{R_B = 1.46\ \Omega}$

Scanned with CamScanner

(C) $\beta_{FORCE} = 1.62$

(C) :- $\beta_{FORCE} = \frac{I_{CS}}{I_B}$

$= \frac{94.9}{59}$

$\beta_{FORCE} = 1.6$

$I_C = \frac{V_{CC} - V_{CE}}{R_C}$

$= \frac{095 - 1}{95}$

$I_C = 94.9A$

(D) :- $P_T = V_{BE} I_B + V_{CE} I_C$

$= 1.5 \times 59 + 1 \times 94.9$

$= 88.5 + 94.9$

$P_T = 183.4 W.$

Scanned with CamScanner