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ID: 13180

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Subject: **power electonic**

Submitted to: **Engr.shahyan tariq sir**

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Department of Electrical Engineering
Assignment
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Course Details

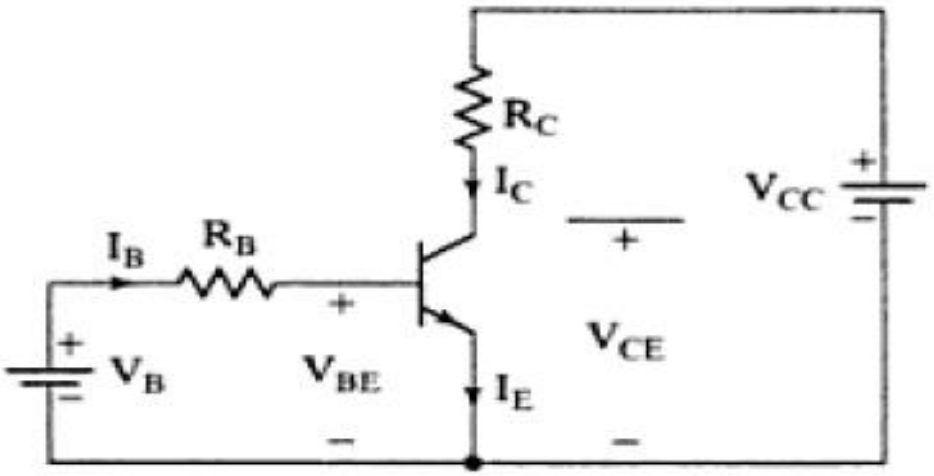
Course Title: Power Electronics **Module:** 8th
Instructor: Engr.shahyan triq sir **Total Marks:** 30

Student Details

Name: farhan shah **Student ID:** 13180

Note: Plagiarism of more than 20% will result in negative marking.
Similar answers of students will result in cancellation of the answer for all parties.

Q1.	(a)	An appliance circuit has a R-L connected in series with a diode. After some time, modification is done to the circuit and a free-wheeling diode in added in parallel to the R-L. Will it have any impact on the performance and output of the circuit. Back your answer with before & after data, facts and figures. Does adding a free-wheeling diode in parallel to a R-C circuit have the same effect, different effect or no effect.	Marks 7 CLO 1
	(b)	A Power Mosfet is connected in a circuit. The Drain to Source voltage, V_{DS} = (Last 2 digits of your student ID) V and Threshold Voltage, V_T = (Last 1 digits of your student ID) V. What is the minimum Gate to Drain Voltage, V_{GS} required for the P.Mosfet to be in saturation mood.	Marks 3 CLO 1
Q2.	(a)	A Power Electronics appliance of 500W, 220V, 500KHz rating is using a Power Mosfet for switching purpose. If the P.Mosfet is replaced with a Power Bipolar Junction Transistor what effect will it have on the performance, losses and efficiency of the appliance. Will any other changes to the circuit be required? Back your reasons with valid data, facts and figures.	Marks 5 CLO 1
	(b)	In the above appliance (Q2.a) if the P.Mosfet is replaced with a Silicon Controlled Rectifier what effect will it have on the performance, losses and efficiency of the appliance. Will any other changes to the circuit be required? Back your reasons with valid data, facts and figures.	Marks 5 CLO 1
Q3.	(a)	The bipolar transistor in the Figure below is specified to have β_F in the range of 8 to 40. The load resistance, R_C = (Last 2 digits of your student ID) Ω.	Marks 10

		The dc supply voltage, V_{CC} = (Last 3 digits of your student ID) V and the input voltage to the base circuit, V_B = 10 V. If V_{CE} = (First digits of your student ID) V and V_{BE} = 1.5 V, 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 β_{forced}, (d) the power loss, P_T in the transistor.	CLO 1
			

Farhan Shah
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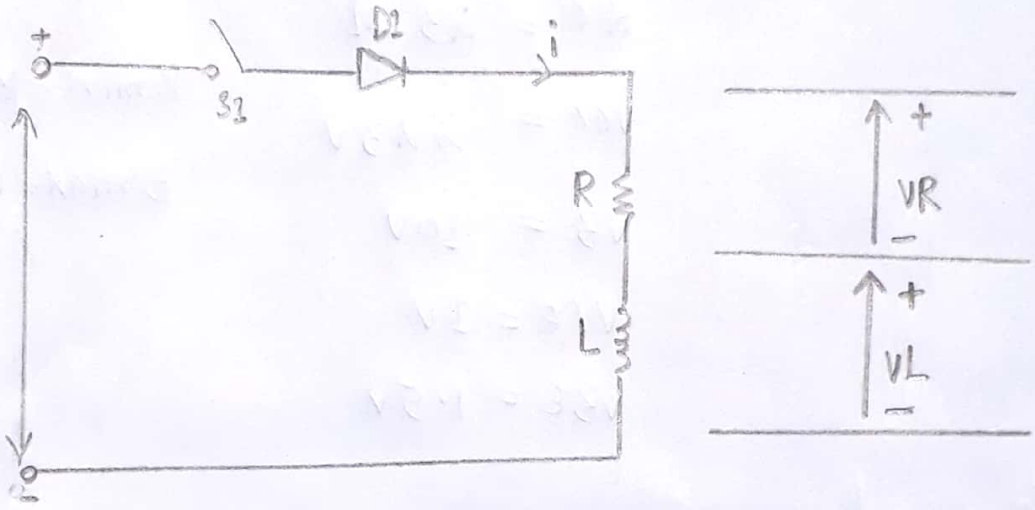
⇒ RL Connected in Series with Diode:-



⇒ When S1 is closed at t=0, the current throug the Inductor Increases and is expressed as:

$$Vs = VL + VR = L\frac{di}{dt} + Ri$$

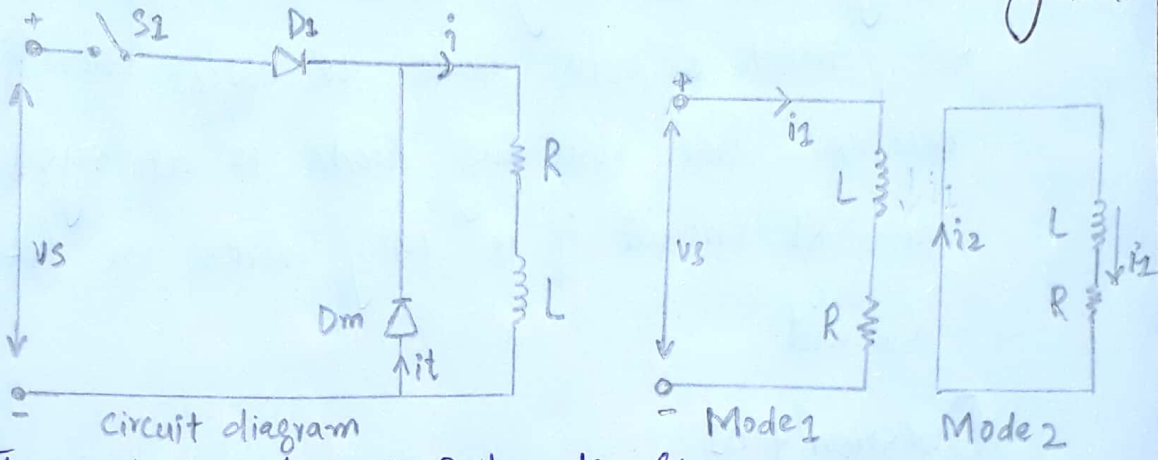
⇒ With the Control Initial condition i(t=0)=0 i(t) is expressed as

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

⇒ The Rate of change of this circuit can be obtained from.

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

⇒ RL Circuit Connected in parallel with wheeling diode.



Circuit diagram

⇒ The Inductor has property to Store energy.

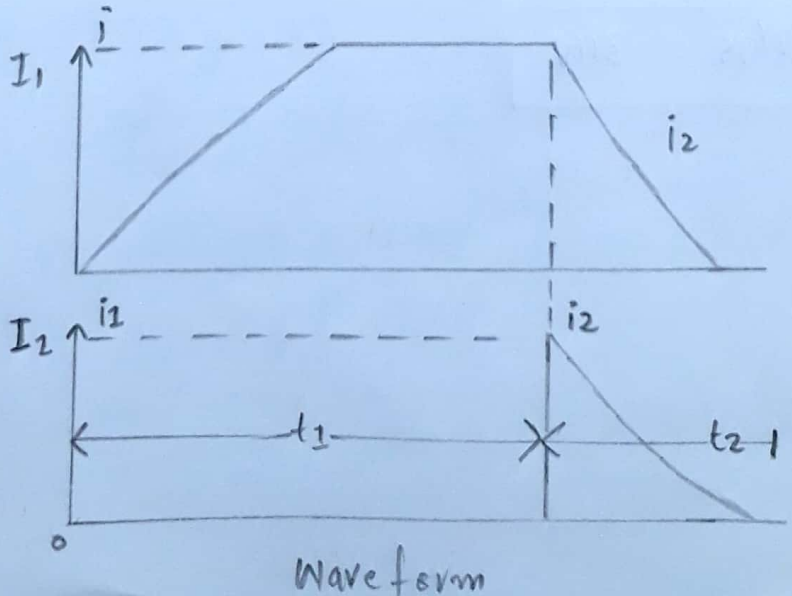
⇒ In Ac current during positive high cycle the Inductor Stores energy.

⇒ At Negative half cycle the Inductor de-engies.

⇒ This may cause reverse demage to circuit.

⇒ To avoid energy descipation free wheeling diode is used.

⇒ In negative half cycle the Free-wheeling diode. because forward bias so the current will flow through diode.



Waveform

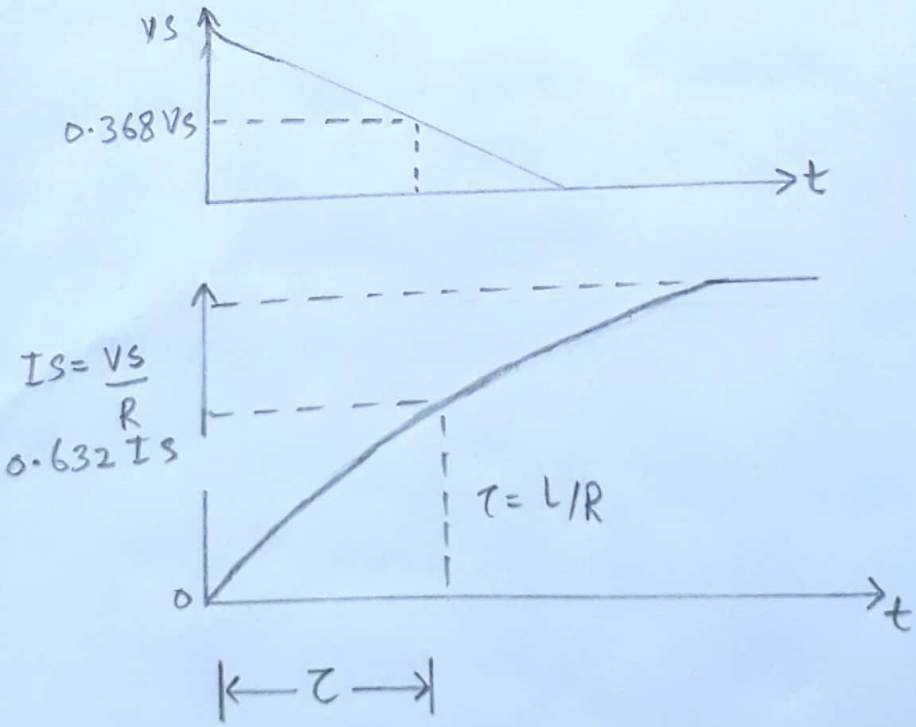
⇒ The Initial rate of rise of the Current (at t=0) is obtained:

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

The Voltages across the inductor is

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

where $L/R = \tau$ is the the time Constant of RL Load. The Waveforms for the Voltage & Current are Shown.



⇒ Adding free wheeling diode in parallel with RC circuit it will have no effect no effect because free wheeling diode is always placed in RL circuit & it only works in RL Circuit.

Question # 01

(Part b)

Data:-

$V_{DS} = 80V$

$V_T = 2V$

Solution:-

For Saturation

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

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

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

$V_{GS} = 80 + 2$

$V_{GS} = 82V$

Question # 02 part(A)

Given Data:-

appliance of 500W, 220V, 500KHz rating using a power Mosfet for Switching purpose.

→ **Reason:-**

IF the power Mosefet is replaced with a power Bipolar Junction Transistor what effect will it have on the performance, losses and efficiency of the appliance.

1) ⇒ BJTs and Mosefts are mainly used in power Electronic Circuits.

2) ⇒ The Switching speed of a BJT is many times Slower that of a Moseft of similar size and rating.

3) ⇒ A BJT is a current Controlled device, and a large base current is required to kept the device in the on state. In addition to obtain fast turn off a higher service reverse base current is required.

4) ⇒ Power Mosfet are voltage controlled devices. They are preferable to BJT in high frequency applications where switching power loss is important. Hower the on state voltage drops of power mosfets higher than that of BJT of similar size and rating. Therefore in high voltage application where on state losses are to be minimized a BJT is prefferred.

5) ⇒ High power BJT are commonly power converters at a frequency below 10KHz and are effectively applied in the power rating upto 1200V, 400A.

6) ⇒ Power Mosfet are used in high speed power converts. these are available at relatively low power rating i-e in the range of 1000V, 100A.

→ Power Bipolar Junction transistors:-

⇒ Power transistor are available in both NPN and PNP. Hower we will connected on the NPN device since it has a higher current and voltage rating than the PNP device.

⇒ application: AC motor control SMPS.

⇒ Maximum VI Rating: 600V/200A

⇒ This is Voltage controlled.

⇒ Type of device: majority carrier.

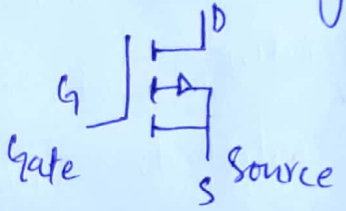
⇒ Communication circuit:- Not necessary.

⇒ Blocking capacity: Asymmetrical

⇒ Temperature :- Positive

⇒ parallel operation:- Easy to parallel

⇒ Symbol:-



The above effect on the perfomence losses and efficiency of the appliance.

⇒ Efficient:-

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

⇒ Mosfet:-

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

⇒ LOSSES:-

losses due to BJT will be low and due to mofset will be higher because mosfet is voltage controlled device and BJT is current control.

Switching of Mofet is higher then BJT.

Question # 03

Given Data:-

$R_C = 23\ \Omega$

$V_{CC} = 223\ V$

$V_B = 10\ V$

$V_{CE} = 1\ V$

$V_{BE} = 1.5\ V$

$B_{min} = 8$

$B_{max} = 40$

To Find:-

(a) Mode of operation of transistor

CDF=5

(b) $R_B = ?$

(c) B Force

(d) Power loss PT in the transistor.

Solution:-

(a) Saturation mode

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

$= \dfrac{223 - 1}{23}$

$I_{CS} = 9.6\ A$

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

$= \dfrac{9.6}{8}$

$IBS = 1.2A$

$CDF = \frac{IB}{IBS}$

$IB = CDF \times IBS$

$= 5 \times 1.2$

$\boxed{IB = 6A}$

$RB = \frac{VB - VBE}{R_1 \cdot IB}$

$= \frac{10 - 1.5}{6}$

$\boxed{RB = 1.41\Omega}$

$BForce = 1.6$

$IC = \frac{VCC - VCE}{RC}$

$= \frac{23 - 1}{23}$

$\boxed{IC = 9.6A}$

$PT = VBEIR + VCEIC$

$= 1.5 \times 6 + 1 \times 9.6$

$9 + 9.6$

$\boxed{PT = 8.6W}$