Department of Electrical Engineering
Assignment
Date: 14/04/2020

Course Details

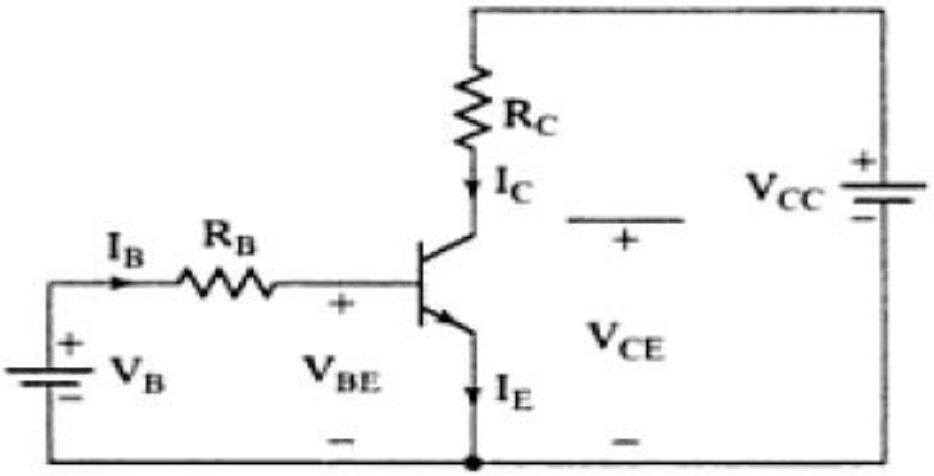
Course Title: Power Electronics **Module:** 8th
Instructor: ENGR. SHAYAN TARIQ JAN **Total Marks:** 30

Student Details

Name: **Raham Zeb** **Student ID:** **13074**

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
			

subject - Power Electronics

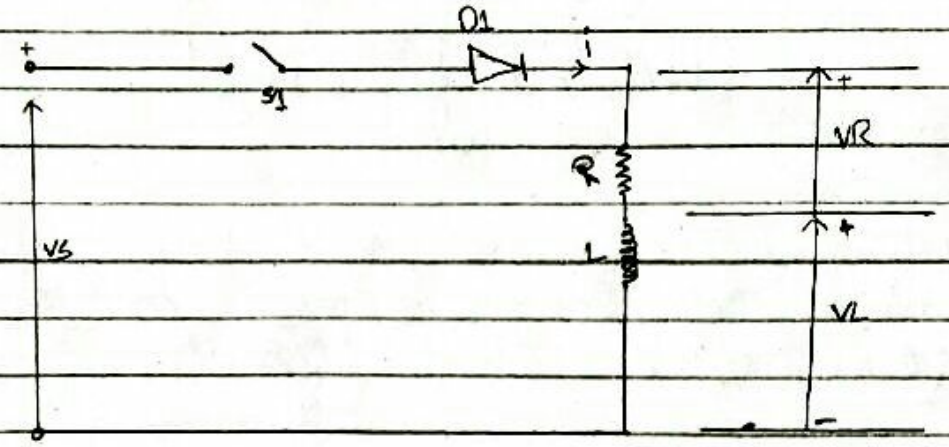
ID = 13074 (H) NAME = Raham Zeb

Question no 1:-

part "a"

Ans:-

⇒ R-L connected in series with diode :-



⇒ when S1 is closed at t=0, the current through the inductor increases and is expressed as

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

⇒ with the 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 at this circuit can be obtained from

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

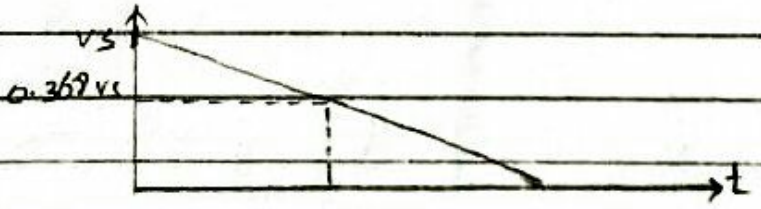
=> The initial rate of rise of the current (at $t=0$) is obtained:

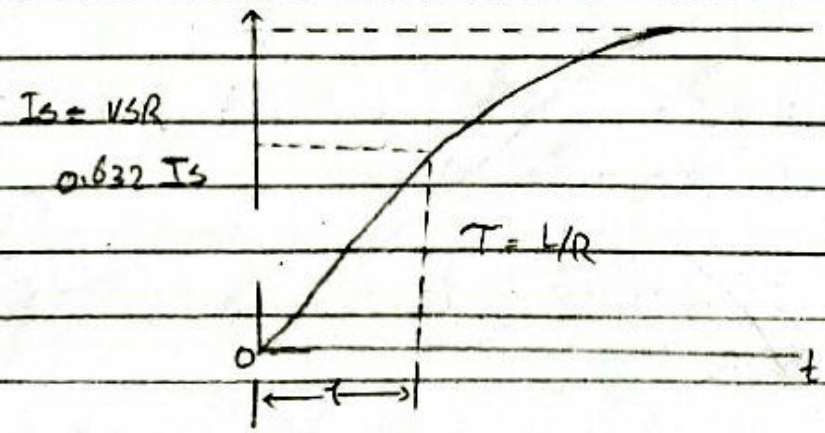
$$\left.\frac{di}{dt}\right|_{t=0} = \frac{V_S}{L}$$

The voltage across the inductor is

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

where $L/R = t$ is the time constant of RL - load. the waveforms for the voltage & current are shown.





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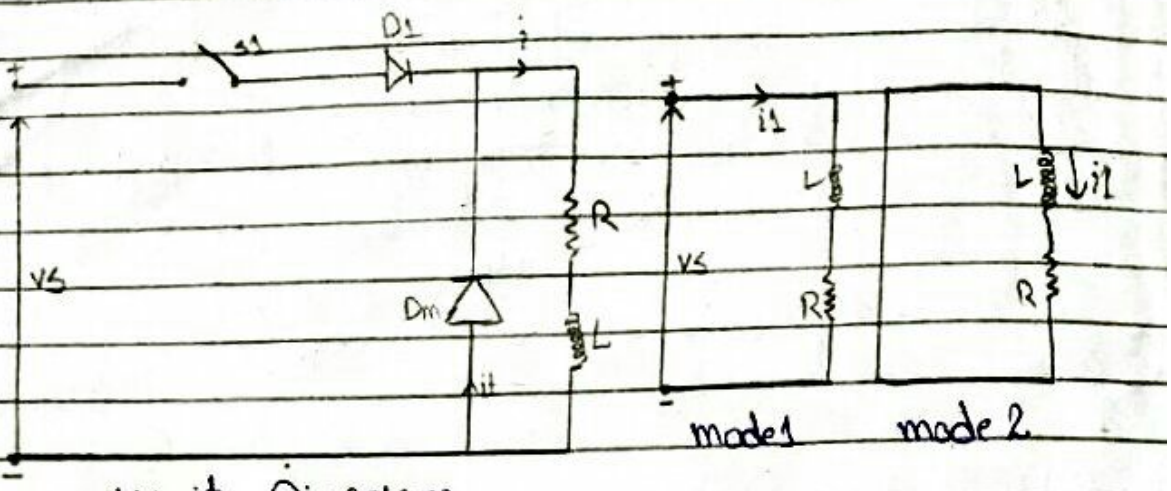
⇒ RL circuit connected in parallel with wheeling diode :-



circuit Diagram

⇒ The inductor has property to store energy

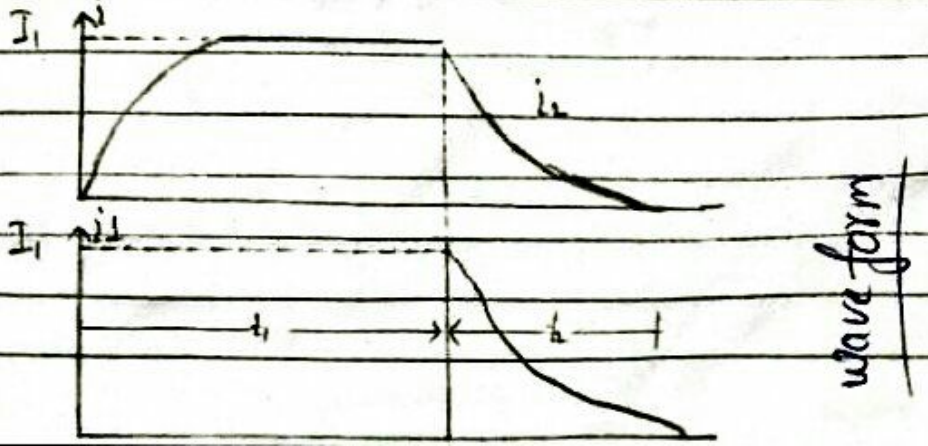
⇒ In AC current during positive high cycle the inductor stores energy.

⇒ At negative half cycle the inductor de-energies.

⇒ This may cause reverse ~~circuit~~ damage to the circuit.

⇒ To avoid energy descipation free wheeling diode is used.

⇒ In negative half cycle the free-wheeling diode become forward bias so the current will through diode.



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Question no1:-

part "B"

solution:-

In saturation where

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

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

$$V_{GS} \leq V_{DS} + V_T$$

$$V_{GS} \leq 74V + 4V$$

$$\boxed{V_{GS} \leq 78V}$$ Ans:-

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Question No: 2

Part (a)

Ans: A power electronic appliance of 220 V. 50 KHz rating is using a power mosfet for switching purpose the power mosfet is replaced with Power bipolar junction transistor. its effect on his performence and losses and efficiency on the appliance the switching frequency will be lower of appliance because mosfet have high switching frequency the biopolar Junction transister. The losses will below because losses in BJT is less them mosfet have high switching frequency them BJT. loss in appliance will below 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 performence.

The frequency of appliance is high and Bjt have low frequency rate. ~~because~~ and Switching frequency need to adjust frequency because is So high.

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Question NO: 2

art (b)

Ans:- The above appliance 2a if the mospet replaced with SCR as switch and impact its performance losses and efficency is given. The SCR can 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 effiency the SCR can protected because of the fuse which can decrease losses used as the performance of the appliance improve.

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Question no 3:- The bipolar transistor in fig is specified to have β_F in the range of 8 to 40.

The load resistance
R_C = last 2 digit of ID ✓7

The dc supply voltage V_{cc} = 3 digit of ID v.

V_B = 10V

V_{CE} = 1 digit of ID v

V_{BE} = 1.5V find:

Solution:-

a) The mode of operation

Data:

V_{cc} = 074
V_B = 10V

V_{CE} = 1 V

V_{BE} = 1.5V

R_C = 74.

(a) As a switch.

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

$= \frac{074 - 1}{74}$

$= 0.986$ Amp.

Now

$I_{BS} = \frac{I_{CS}}{\beta_{min}} = \frac{0.986}{8}$

$I_{BS} = 0.123$ A

$I_B = ODE \times I_{BS}$

$I_B = 5 \times 0.123$

$= 0.615$ A

Now we have $I_B = \frac{V_B - V_{BE}}{R_B}$

$R_B = V_B - V_{BE} / I_B$

$R_B = \frac{10 - 1.5}{0.615}$

$= \frac{8.5}{0.615}$

$\boxed{R_B = 13.821\ \Omega}$

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(c) $B_F = \frac{I_{CS}}{I_B} = \frac{0.986}{0.615}$

$$\boxed{B_f = 1.586}$$

D) $P_T = V_{BE} I_B + V_{CE} I_{CS}$

$P_T = 1.5 \times 0.615 + 1 + 0.986$

$= 0.922 + 0.986$

$$\boxed{P = 1.908 W}$$