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

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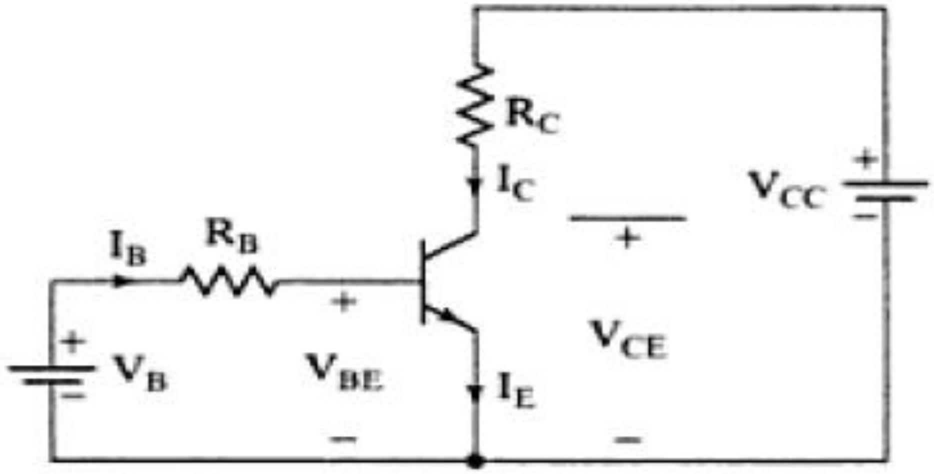
Note: Plagiarism of more than 20% will result in negative marking.
Similar answers of students will result in cancellation of the answer for all parties.

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

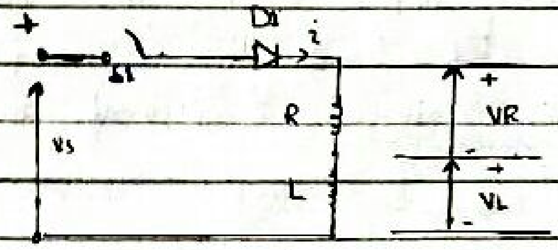
		The dc supply voltage, V_{CC} = (Last 3 digits of your student ID) V and the input voltage to the base circuit, V_B = 10 V. If V_{CE} = (First digits of your student ID) V and V_{BE} = 1.5 V, find (a) The mode of operation of the transistor (b) the value of R_B that results in saturation with an ODF of 5, (c) the β_{forced}, (d) the power loss, P_T in the transistor.	CLO 1
			

Subject power electronics ID 13171

Question No 1:

Part a

i) R-L Connected in series with diode



* When S1 is Closed at $t=0$, the Current through the inductor increases 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

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

* The rate of Change of this Circuit Can be obtained from

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

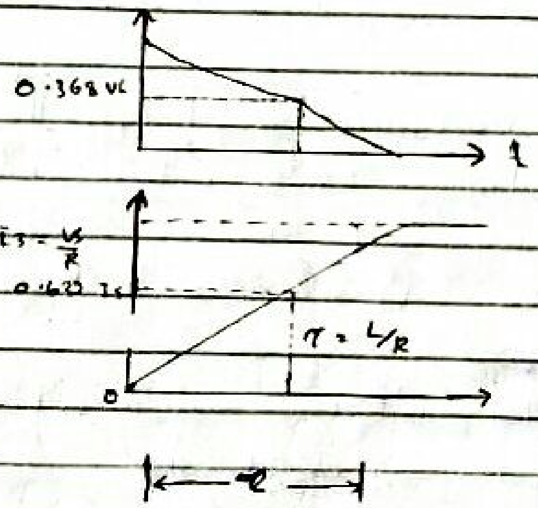
* The initial rate of rise of the Current (at $t=0$) is obtained:

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

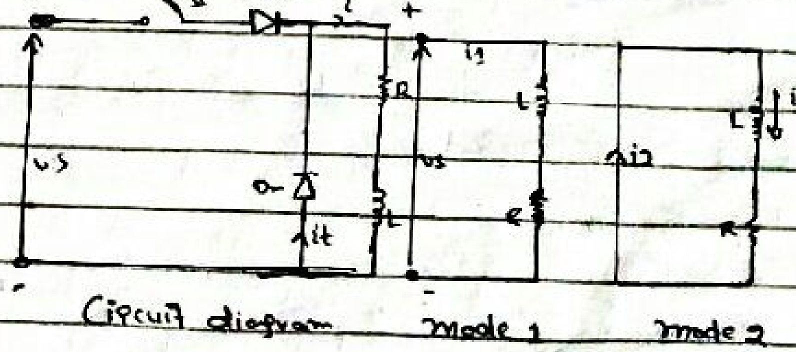
The Voltage across the inductor is

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

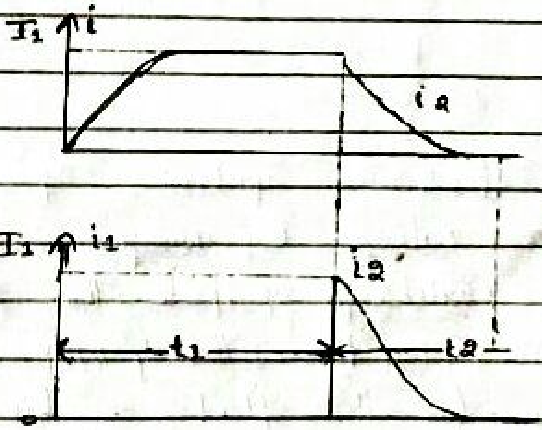
Where L/R = τ is the time constant of RL Load. The wave form for the Voltage & current are shown.



- RL circuit connected in parallel with Wheling diode:



- 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 damage to circuit.
- To avoid energy description free wheeling diode is used
- In negative half cycle the free wheeling diode becomes forward bias so the current will flow through diode



Wave form

Q1 (b) Drain to Source Voltage : VDS = 71 V
Threshold Voltage : VT = 1 V
Min Gate to Drain Voltage
VGS = ?

Sol:

In Saturation
where

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

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

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

$$V_{GS} \leq 71V + 1V$$

$$V_{GS} \leq 72V$$

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QNo 2 Part (a)

A power electronic appliance of 500W 220V 50KHZ rating is using a power mosfet for switching purpose. The power mosfet is replaced with power Bipolar Junction transistor. its effect on his performance and based and efficiency on the appliance
The switching frequency will be lower of appliance. because mosfet have high switching frequency the Biopolar 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 Canal

operate at high frequency one of the impact on performance 500kH. 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 replace ment in appliance on the high frequency BJT are less efficient 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.

QNo 2 part B:

The above appliance 20. If the mosfet replaced with SCR as switch and impact its performance losses and efficiency is given. The SCR have no capabilities to handle high frequencies and

and Will impact on its performance
The SCR an handle more power
Voltage current which increase the
efficiency of the appliance and one
of the advantages. efficiency.

The SCR Can protected because
of the fuse Which Can decrease
losses used as the performance of
the appliance improve

Q No 3 a

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 Ω

The DC supply Voltage V_{CC} = 3 digit of ID V
$V_B = 10$ V
V_{CE} = 1 digit of ID V
$V_{BE} = 1.5$ V find

(a) The mode of operation

Data:

$V_{CC} = 171$

$V_B = 10V$

$V_{CE} = 1 V$

$R_C = 71$

(a) as a switch

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

$= \frac{171 - 1}{71}$

$= 2.394$ A.

Now

$I_{BS} = \frac{I_{CS}}{\beta_{min}} = \frac{2.394}{8}$

$I_{BS} = 0.299$ A

$I_B =$ ODE $\times I_{BS}$

$= 5 \times 0.299$

$= 1.495$ A.

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

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

$R_B = \frac{10 - 1.5}{1.495}$

$R_B = 5.685\ \Omega$

~~RB =~~

(c) $\beta_F = \frac{I_{CS}}{I_B} = \frac{2.394}{1.495}$

$\beta_F = 1.601$

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

$P_T = 1.5 \times 1.495 + 1 \times 2.394$

$P_T = 2.242 + 2.394$

$P_T = 4.636\,W$