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

Course Details

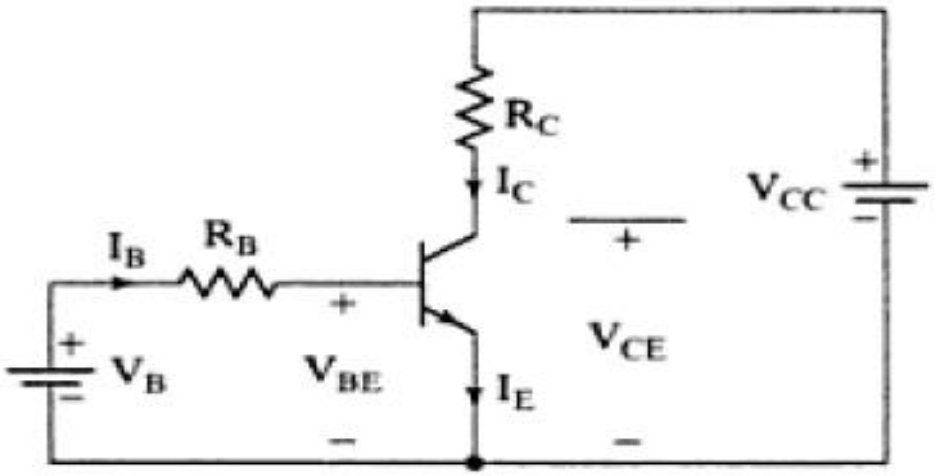
Course Title: Power Electronics **Module:** _____
Instructor: _____ **Total Marks:** 30

Student Details

Name: Okash Ahmad **Student ID:** 13223

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
			

NAME

ID

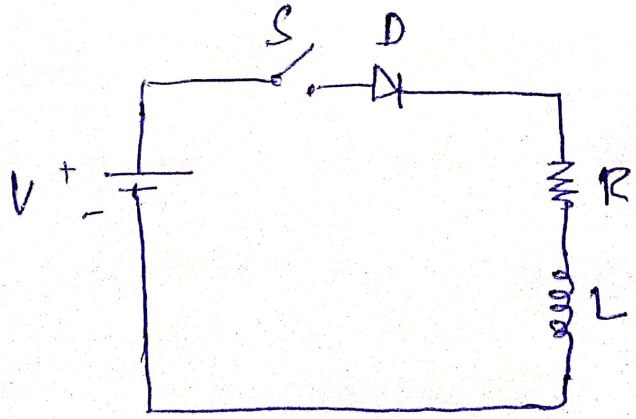
OKASH AHMAD

13223

Q#1(a) An Application Circuit has a R-L Connected in Series with diode. After Some time, modification is done to the Circuit and free wheeling diode in added in parralled to RL Will it have any Impact on the performance and output of the Circuit. Back your answer with before and after data fact and figures

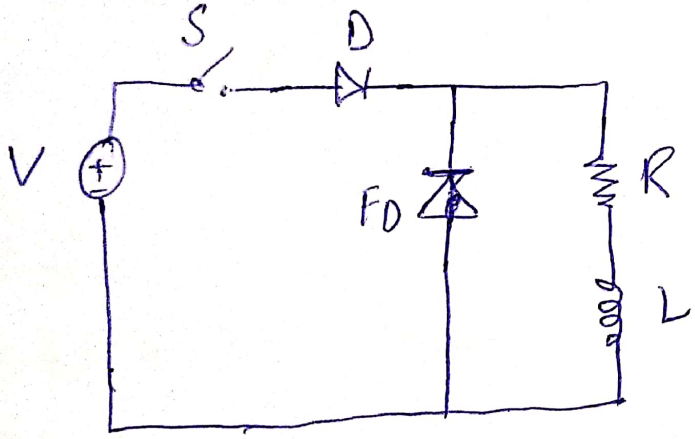
Does adding a free wheeling diode in parralled to RC circuit have the Same effect, different effect or no effect.

Ans:-



When the Switch is closed the Steady State current flows Through the Circuit.

When we open the Switch the steady value will become Zero which will result high value of $\frac{di}{dt}$ Since, the current is Zero therefore, $\frac{di}{dt}$ will high and hence the voltage This high voltage can cause damage to both diode and Switch.

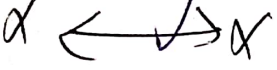


When The Switch is closed a steady current will flow Through the load. When we open the Switch the current will Start to decay. This decay of current will result in developement of voltage across the Terminals of inductor due to This voltage The free Wheeling diode will be forward bias and it will act like

a

for the flow of decay current Short Circuit Thus provide a path

As We know that the inductor release energy while Capacitor stores energy. Therefore, when the switch is open the inductor release energy while Capacitor stores energy So, the R-C circuit has different affect. ~~At Compare to R-L circuit.~~ Because There is no voltage flowing through the free wheeling diode.



~~Q#1(b)~~

Q#1(b) A power MOSFET Connected in circuit The Drain to Source voltage, V_{DS} = (last 2 digit of ID)V and threshold voltage V_t (last 1 digit of 20)V What is the minimum Gate to Source voltage V_{GS} required for the P-MOSFET to be in Saturation mood.

Ans. Solution:

Data- $V_{DS} = 23V$

$V_t = 3$

for Saturation mood.

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

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

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

$$V_{GS} = 23 + 3$$

$$\boxed{V_{GS} = 27V}$$

X ⟷ Y

Q/2 (a) A power Electronic Appliances of 500w 220V, 500KHz rating is using a power MOSFET for Switching purpose. If the P.MOSFET is replaced with P.BJT 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 reason with valid data fact and figures.

Ans: A P.MOSFET is a voltage Controlled device while P.BJT is a current controlling device.

- MOSFET have high Switching frequency than BJT and appliances Switching frequency will be

lower. It will effect the performance of Switching.

- P-MOSFET have higher losses than BJT So, it will improve the effeciency of appliances.
- Switching is the biggest problem where BJT in appliances is used.
- Conduction losses will be decrease because of BJT replacement in appliances.
- In MOSFET driver circuit is simple and easy to design while in BJT it is very complen to design.
- There will be no changes in the circuit.

X ⟷ X

Q|2(b) In the above appliances (Q2.a) if the P-MOSFET is replaced with SCR what effect will it have on the performance, losses and efficiency of the appliances. Will any other changes to circuit be required? Back your reason with valid data, fact and figure.

Ans: SCR has more robust device than P-BJT it increase the efficeny of the appliances.

- SCR has high current as well as high voltage which increase the efficiency of appliances.
- SCR will have no ability to bear high frequency, so it will come in ~~efficiency~~ losses. performance of appliances
- The switching capacity of SCR is not good as P.MOSFET (losses).
- It will no effect in circuitry.
- losses of using SCR as switching over P.BJT is given below
  - gate trigger losses
  - on state losses
  - off state losses
  - switching losses

Q/3 (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 digit of ID) Ω.

The dc supply voltage, V_{CC} = (last 3 digit of ID) & V

and the Input Voltage to the base circuit $V_{BE} = 1.5V$, find.

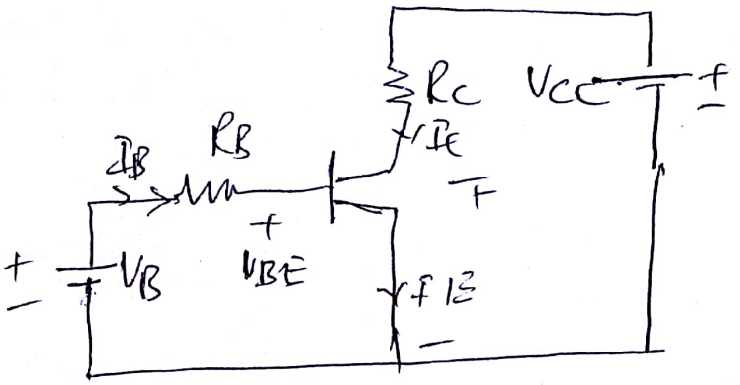
(a) The mode of operation of the transistor

(b) The value of R_B that result in Saturation with an ODF of 5,

(c) The β_{forced},

(d) The power loss, P_T in the transistor.

Ans:



Solution:

Data:

$R_C = 23\Omega$ $\quad \beta_{min} = 8$

$V_{CC} = 223V$ $\quad \beta_{max} = 40$

$V_B = 10V$

$V_{CE} = 0V$

$V_{BE} = 1.5V$

(a) Mode of operation of transistor.

(b) $R_B = ?$

(c) β_{force}

(d) Power loss P_T in transistor.

(a) Saturated mood.

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

$= \frac{22 - 1}{23}$

$\boxed{I_{CS} = 9.6\,A}$

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

$= \frac{9.6}{8}$

$\boxed{I_{BS} = 1.2A}$

$ODF = \frac{I_B}{I_{BS}}$

$I_B = ODF \times I_{BS}$

$= 5 \times 1.2$

$\boxed{I_B = 6A}$

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

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

$$\boxed{R_B = 1.41\ \Omega}$$

$$B\,Force = \frac{I_{CS}}{I_B}$$

$$= \frac{9.6}{6}$$

$$\boxed{B\,force = 1.6}$$

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

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

$$\boxed{I_C = 9.6\ A}$$

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

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

$$= 9 + 9.6$$

$$\boxed{P_T = 18.6\ W}$$