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

Course Details

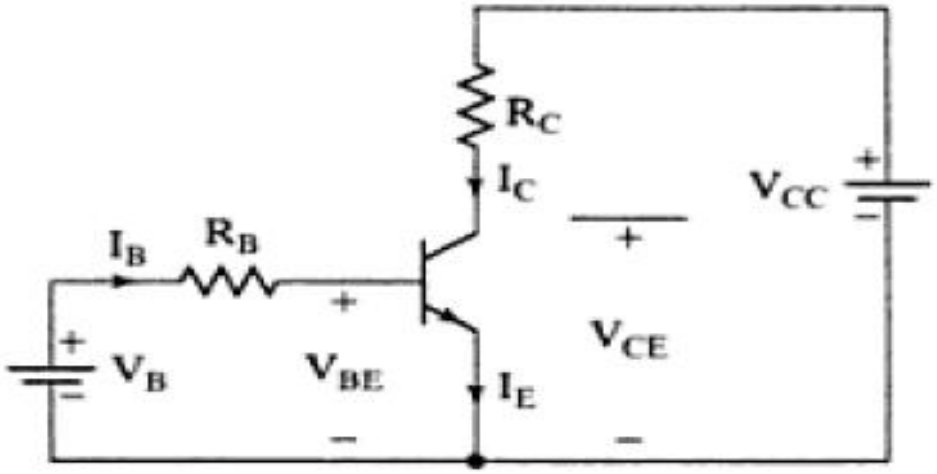
Course Title: Power Electronics **Module:** 8th
Instructor: Sir Shayan Tariq Jan **Total Marks:** 30

Student Details

Name: Rafi Ud Din **Student ID:** 12401

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
			

Q No 1

a) An appliance circuit has a RL 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 RL with it have any impact on the performance and output of the circuit and Back your answer before and after data facts and figures.
Does adding a free wheeling diode in parallel to a R-L circuit have the same effect different effect or no effect.

Ans:- An appliance circuit has RL load connected in series with diode. when the free-wheeling diode is added in parallel to RL load it will reduce the ripples. and prevent the load current from zero - It has no impact on the performance. If we added free wheeling diode with RL instead of RL The The effect is same the difference in the load voltage and prevent it from leading to zero.

Q NO 1

b) A Power MOSFET is connected in a circuit
The Drain to source voltage, $V_{DS} = 01V$ and Threshold voltage $V_T = 1V$
What is the minimum Gate to source voltage V_{gs} required for the power MOSFET to be in staturation mood.

ID 12401

Solution:-

Given data.

$V_{DS} = 01V$

$V_T = 1$

To Find:-

Minimum gate to source voltage For the power MOSFET to be in staturation mode.

As we know that the P.MOSFET for staturation

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

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

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

$$V_{GS} = 01 + 1$$

$$\boxed{V_{GS} = 2V}$$

Q NO2

a) A power electronic Appliance of 500W 220V, 500KHz rating is using in P MOSFET for switching purpose. If the P. MOSFET replace with the power Bipolar Junction transistor what effect will it have on the performance losses and the effiency of the appliance will any other changes to the circuit be required? Back your reasons with valid data facts and figure.

Ans:- Power MOSFET is a electronic device use for switching purpose if we replace MOSFET with BJT (Bipolar junction Transistor) The losses in switching is increse In BJT switching losses is directly proportional to frequmy if the losses increse Then the performance and effiency of the appliance will decrese.
And the losses leads to heat it damage the BJT and appliance both. Overcurrent and overvoltage protection are necessery so the snuber circuit is ~~also~~ to limit the fluctuation in the voltage.

b) In the above appliance (Q NO2 a) if the P MOSFET is replace with silicon controlled Rectifier what effect will it have on the performance losses and ~~effien~~ effiency of the appliance will any other

Changes to the circuit be required? Baele your reasons with valid data facts and figure.

Ans:- If we replace the power MOSFET with SCR the SCR will reduce the performance and effiency of the appliance Because the SCR experience four type of losses

→ On-state losses
→ Off-state losses
→ Switching losses
→ Gate trigger losses.

Beside these losses if we take take switching losses. the switching losses of SCR is very less below the 4KHz frequny but if we increses the frequny from 4KHz then losses also incresed. thats why The performance and effiency of the Appliance are reduced.

QNo3

a) The Bipolar transistor in the figure below is specified to have βF in the Range of 8 to 40.
The Load Resistance Rc = 01 Ω
The DC supply voltage Vcc = 401V
and the input voltage to the base Circuit VB = 10V
. IF VCE = 1V and VBE = 1.5 V

Find:-

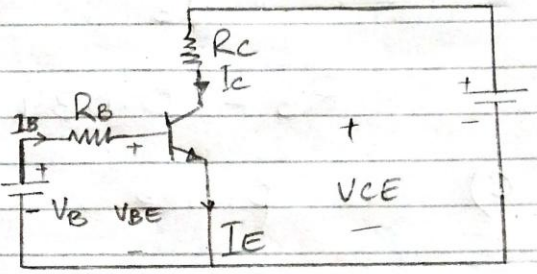
a) The mode of operation of the transistor
b) The value of R_B that results in saturation with an ODF of 5.
c) The β_{forced}
d) The power loss P_T in the transistor:.

Solution:-

Given Data

MY ID 12401

$R_C = 01\Omega$
$V_{CC} = 401V$
$V_B = 10V$
$V_{CE} = 1V$
$V_{BE} = 1.5V$



To Find.

a) The mode of operation of the transistor is staturation mode.

b) As we know that

$$I_{cs} = \frac{V_{cc} - V_{CE(sat)}}{RC}$$

$$= \frac{401 - 1}{01}$$

$$I_{cs} = 400\,A$$

$$I_{BS} = \frac{I_{cs}}{B_{min}} = \frac{400}{8}$$

$$I_{BS} = 50\,A$$

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

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

$$I_B = 5 \times 50$$

$$I_B = 250A$$

$$R_B = \frac{V_B - V_{BE}}{I_B} = \frac{10 - 1.5}{250}$$

$$R_B = 0.034\ \Omega$$

c) The β_{Force}

$$\beta_F = \frac{I_{cs}}{I_B} = \frac{400}{250}$$

$$\beta_F = 1.6$$

d) The power loss P_T in the transistor

$$As\ I_c = \frac{V_{cc} - V_{CE}}{R_C}$$

$$= \frac{401 - 1}{01}$$

$$I_c = 400$$

So

$$P_T = V_{BE} I_B + V_{CE} I_c$$
$$= 1.5 \times 250 + 1 \times 400$$
$$= 375 + 400$$
$$P_T = 775\ W.$$