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

Course Details

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

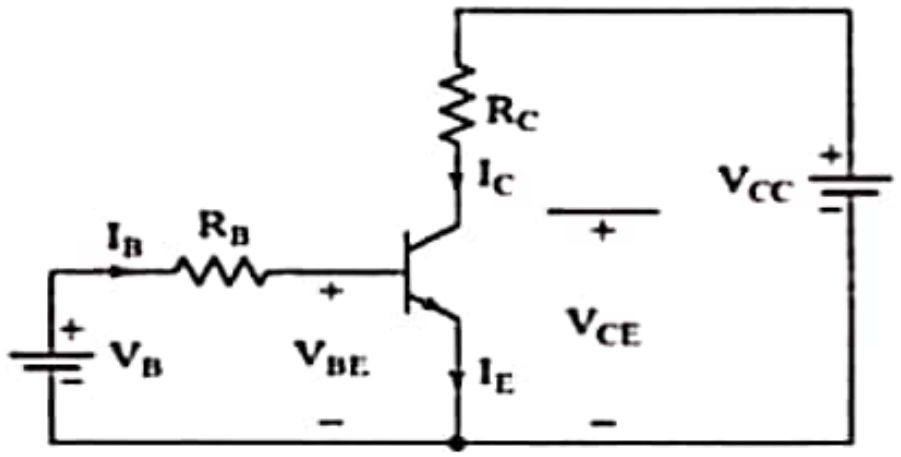
Student Details

Name: _____ **Student ID:** _____

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. 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	Marks 10 CLO 1

(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.



Q1 (a)

Ans:- An appliance circuit has a R-L load connected in series with diode. When freewheeling diode is added in parallel to RL-load. Then it will only reduce the ripple and prevent the load current from loading to zero. And it has no compact on halfwave rectrification.

Secondaly if R-C is taken instead of R-L then effect will be same. The only difference will be the load voltage and it can be prevented from tending to zero.

Q2 :-

(a)

Ans :- A power electronic appliance of 500w, 220v and 500khz is rating is using power mosfet for switching purpose. If mosfet is replaced with BJT then switching losses will be increased. Because in BJT switching losses is directly proportional to frequency if loses increase the performance will decrease. Secondaly due to loses of heat increases it may damage the BJT and appliance too. So overcurrent and over voltage protection are necessary but along this a snubber circuit is also compulsory to limit in fluctution in voltage.

Q2 :-

(b)

Ans :- If mosfet is replaced with SCR that the effect will be given as below. An SCR experience for types of loses

1. ON-state losses
2. OFF-state losses
3. Switching losses
4. Gate trigger losses

Besides all other losses if we take switching losses then the switching losses of SCR are very less below the 4khz frequency, but if frequency increases losses also increases it means that SCR also reduced the performance and efficency. So we should restricted to the use of mosfet.

Q3 :-

(a)

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

Given data V_{CC} is (Last 3 digit of ID)

So, $V_{CC} = 646$

$V_B = 10V$

$V_{CE(sat)} = 11$ (First two digit of ID).

$V_{BE} = 1.5V$

$R_C = 46\,\Omega$ (Last two digit)

Required solution

Formula

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

$$I_{CS} = \frac{646 - 11}{46} = 13.80\,A$$

Therefor

$$I_{BS} = \frac{I_{CS}}{\beta_{min}} = \frac{13.80}{8} = 1.72\,A$$

So,

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

$$= 5 \times 1.72$$

$$\boxed{I_B = 8.6\ A}$$

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

$$R_B = \frac{V_B - V_{BE(sat)}}{I_B} = \frac{10 - 1.5}{8.6}$$

$$\boxed{R_B = 0.98\ \Omega}$$

Part (B) :-

$$Bf = \frac{I_{CS}}{I_B} = \frac{13.80}{8.6} = 1.60$$

Part (C) :-

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

$$= 1.5 \times 8.6 + 11 \times 13.80$$

$$P_T = 12.9 + 151.8$$

$$\boxed{P_T = 164.7\ w}$$