Birzeit University
Electrical and Computer Engineering Department
Power Electronics EE3305
Quiz# 1
Fall 2014

Student Name: ID:

Problem #1: Define the latching current for an SCR, and explain with the aid of drawing the equivalent circuit model of an SCR, why it latches!

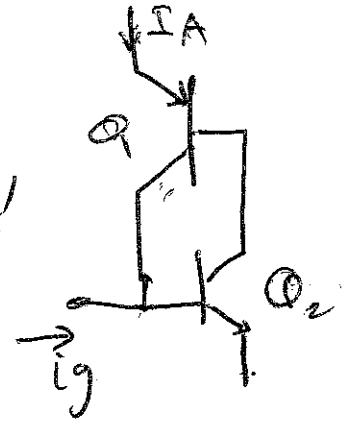
Problem # 2: What modifications are made, when manufacturing, to a GTO to attain turn-off capability?

Problem # 3: With the aid of drawing layers' structure, explain why the power BJT does not have reverse blocking capability!

Problem # 4: What is meant by the Safe Operating Area of a power electronic device? What is its significance? Draw!

Problem #1: Latching current is the minimum Anode current that has to flow in the SCR ~~immediately~~ to maintain the SCR in the on-state immediately after the turn on of the SCR and the removal of gate signal

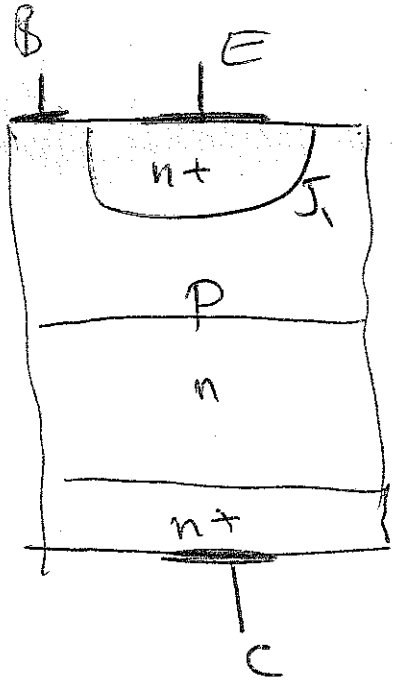
~~to~~ turning on Q_2 turns on Q_1 and Q_1 turns on Q_2 and so forth!



Problem #2 GTO turns off due to:

1. Anode short → speeds turning off
2. n+ wells → sink to holes
3. life time control
4. interdigitated gates → for faster switching

Problem #3

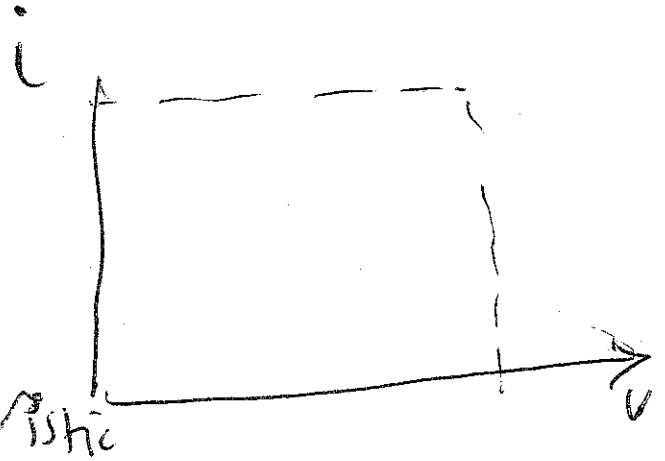


BJT does not have a junction for Reverse blocking

only J_1 is responsible for forward blocking

Problem #4:

Safe operating Area where the switch can be operated safely in the I-V characteristic



if SOA is a square shape the switch does not need snubbers for turn on or off.

Birzeit University
Electrical and Computer Engineering Department
Power Electronics EE3305
Quiz# 1
Fall 2014

Student Name: _____ ID: _____

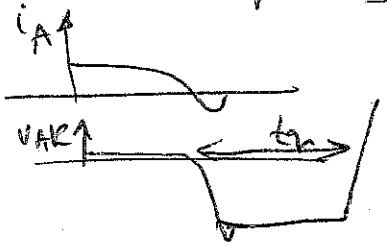
Problem #1: Define the turn-off time of an SCR! Draw!

Problem # 2: How does the reverse recovery charge affects the switching characteristic of a power diode? Explain with the aid of drawing turn off waveforms!

Problem # 3: Why a small gate resistor is needed to switch a Power MOSFET, explain with the aid of drawing the small signal model of a Power MOSFET!

Problem # 4: Explain, with the aid of drawing the layers' structure of a Punch-Through IGBT, why it does not have reverse blocking capability!

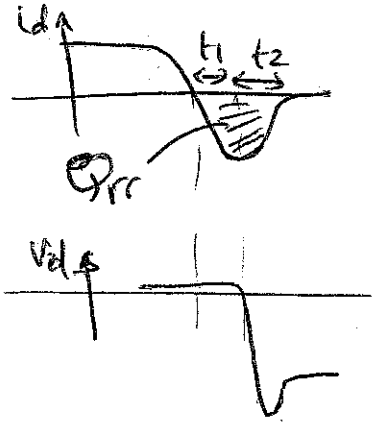
Problem #1: Turn-off time is the time interval between the instant when the principal current falls to zero, when a reverse voltage is applied across the SCR, and the instant when the SCR is capable of supporting a forward voltage without turning on



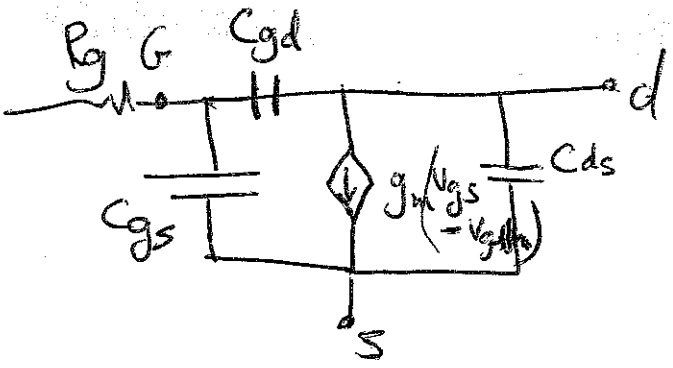
Problem #2:

The charge in the diode has to be removed by the reverse recovery current before the diode turns off and supports voltage. It is the Area under the reverse recovery current

for soft Reverse recovery $S = \frac{t_2}{t_1} \geq 1$ (must be)

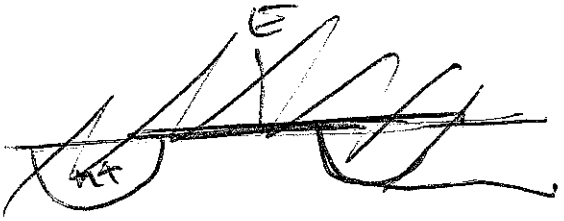


Problem # 3

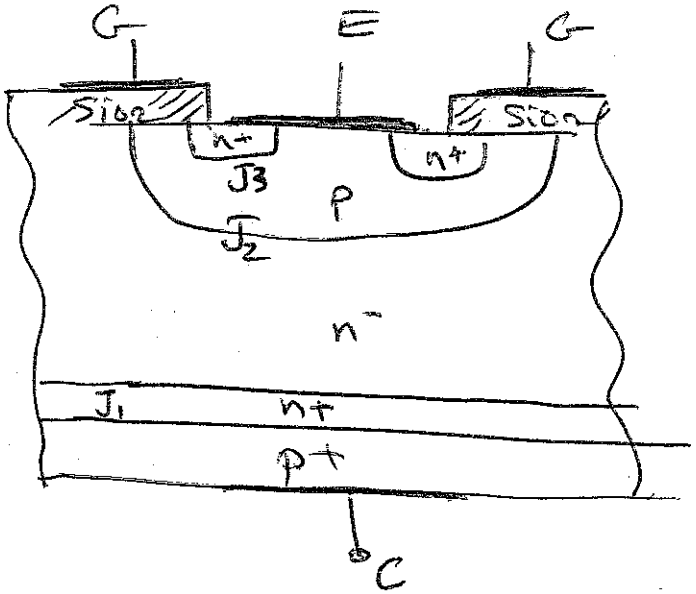


Rg is needed to limit the charging & discharging input Capacitance of power MOSFET, also to stabilize the gate voltage

Problem # 4



J_1 cannot block reverse voltage because it does not have lightly dopped region at both sides of junction



also J_3 cannot block reverse voltage because no wide region to accomodate depletion layer and no lightly dopped at either side.