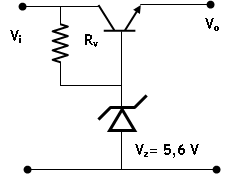
**ELE222E INTRODUCTION TO ELECTRONICS (12482)**

**Midterm Exam #1** 🖉 **6 NOVEMBER 2012** ⌛ **15.30-17.30**

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1. You have a diode with the following doping parameters: **ND** = 2,5·1017 /cm3  , and **NA** = 1,5·1016 /cm3. Other important parameters to consider are: **Ln** = 8 μm, **Lp** = 3 μm, **μn** = 1600 cm2/Vs, **μp** = 400 cm2/Vs,   
   **ni** = 1,5 1010 /cm3, **q** = 1,602 10-19 C, **εr** = 12, **εo** = 8,85 10-12 F/m, **VT** = 25 mV. (30 points)
   1. Find the barrier voltage and saturation current for a junction area of 0,05 mm2. (9 points)
   2. Calculate the specific conductivities of n- and p-type doped silicon. (2x3 points)
   3. Determine the depletion zone width (i )in unbiased state, (ii) when the junction is reverse biased at 5 V and (iii) when it is forward biased at 0,6 V. (3x3 points)
   4. Calculate the junction capacitances for the cases in (**c**). (3x2 points)
2. The figure right shows voltage regulator. The load currentis supplied by the transistor whose base is connected to the Zener diode. Thus the transistor's base current (**IB**) forms the load current for the Zener diode and is much smaller than the current through the load (**IE**). **|VBE|** = 0,6 V, **hFE** = 100, **IE** = 100 mA, and **VZ** = 5,6 V, **IZmin** = 10 mA to produce a stable voltage. (35 points)
   1. Find **Vo** when **Vi** varies between 8 to 11 V with proper load connected to the output.
   2. Estimate the minimum value for **RV** .
3. Study DC characteristics of the 2-stage BJT amplifier circuit shown on the right with **|VBE|** = 0,6 V,   
   **hFE** = 200 for all three transistors. (35 points)
   1. Design a current source that will provide 0,4 mA biasing current to the differential stage. (10 points)
   2. Choose **RC3** such that **Vo** = 0V. Do NOT neglect base currents. (25 points)



SOLUTIONS:

1. Exactly the same problem as in ELE222E INTRODUCTION TO ELECTRONICS (21134) Midterm Exam #1.

Using Einstein Equation , i.e., , we find  and 

;  


unbiased   
with reverse bias at 5 V,   
with forward bias at 0,6 V,   
Thus, 

1. Similar problem to that in ELE222E INTRODUCTION TO ELECTRONICS (21134) Midterm Exam #2 -check out <http://www.satcure-focus.com/tutor/page5.htm> ....

The voltage at base connection is 5,6 V. The voltage between base and emitter of a silicon transistor is always 0,6 V if the transistor is "on". So the voltage at the emitter (Vo) must be 5,6 – 0,6 = 5 V. The output voltage will remain at a constant voltage of 5 V provided that the input voltage from the supply is more than 6 V (the Zener voltage plus a little to compensate for that "lost" across the resistor). In fact the input voltage can be swinging up and down between, say, 6 and 12 V and the output voltage emitter will still be a steady 5 V.

The circuit which this regulator is driving needs 5 V at a current of 100 mA. Since its gain is 100 it's easy to see that it will need at least 1mA into its base to allow 100 mA to flow from collector to emitter. The Zener diode requires a minimum of 10 mA, making a total of 11 mA through Rv. If the minimum/maximum supply voltage is 8/11 V then the minimum voltage across Rv is 2,4 V.

Using Ohm’s Law:



1. Exactly the same problem as in ELE222E INTRODUCTION TO ELECTRONICS (11245) Midterm Exam #2…. You can easily design the current mirror. So this part is left to you. Without neglecting the base currents of the differential (the very first) stage, for Vi = 0 V



I = 0,4 mA

T5

R4

+VCC = +10V

T3

4k7

T1

T2

T1

T2

22k

22k

-VEE = -10V

**Vo**

RC3

Following the brown loop   
  