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Course: Electronic Circuits for Mechatronics (ELCT 609)
Semester: 6th Mechatronics (Spring 2021)

Assignment 1
(Submission date: 10th May 2021)

Problem 1:

For the diode circuit shown in Fig. 1, D_1 and D_2 are battery modeled diodes. If 'V_i' is a sinusoidal signal with 1 kHz frequency and amplitude voltage of 20V,

1. Plot 'V_o' versus 'V_i'
2. Plot 'V_o' versus time

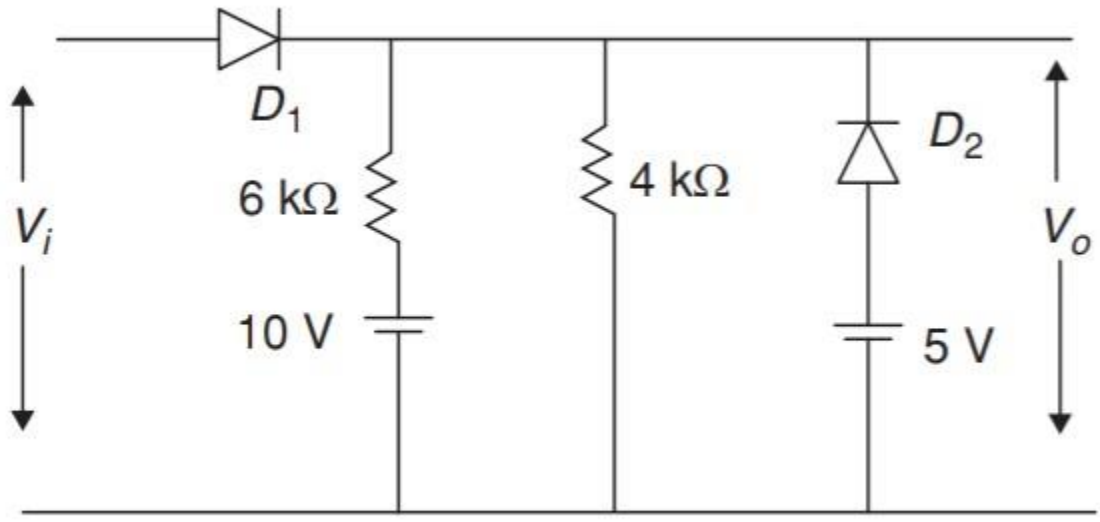

Figure 1

Problem 2:

I_D-V_D characteristics of both D_1 and D_2 in Fig.2 is approximated using a constant battery model of 0.6V; "V_{in}" is a sinusoidal signal with amplitude 10V and 1 kHz frequency; R_1=R_2=2kΩ and V_B=1.4V.

- Derive the circuit output voltage "V_{out}", "I_{D1}" and "I_{D2}" as a function in "V_{in}"
- Sketch "V_{out}", "I_{D1}" and "I_{D2}" vs. "V_{in}"
- Sketch "V_{out}" vs. time

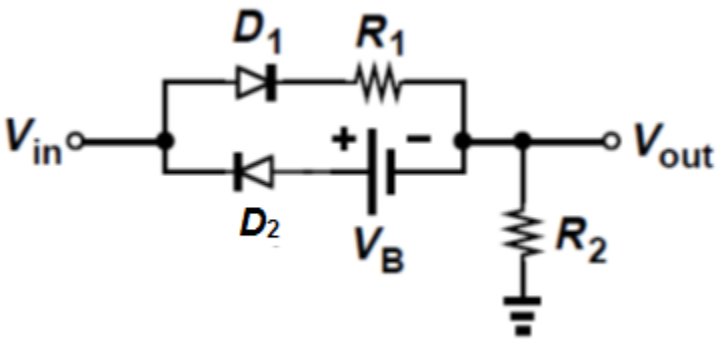

Figure 2

Problem 3:

Using battery modeled diodes, design the following limiters Transfer functions given in Fig. 3 while assuming V_i is a variable voltage source

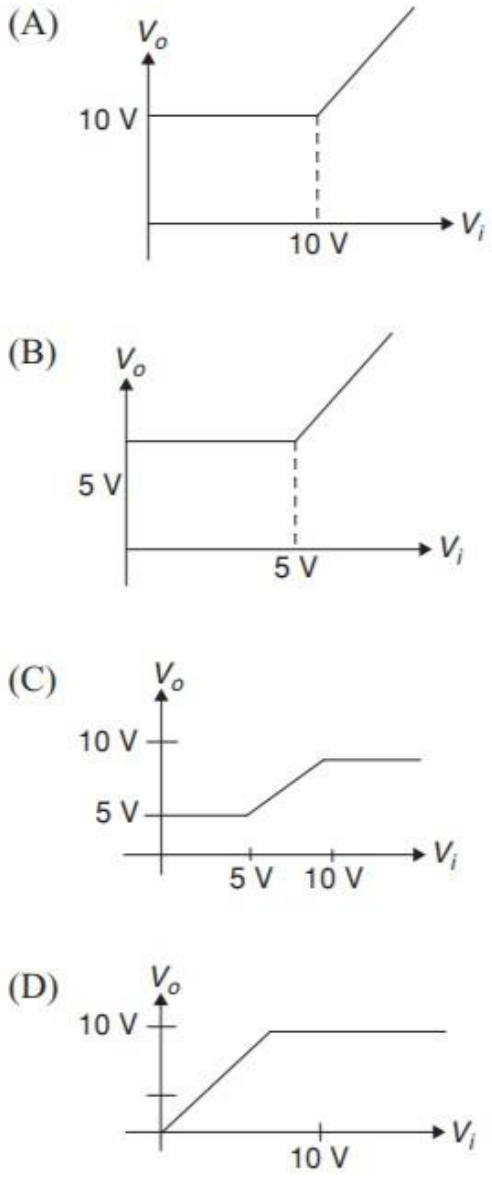

Figure 3

Problem 4:

For the BJT Circuit shown in Fig.4 below,

- What is the minimum value for R_e so that the transistor's work in the saturation region?
- If R_e=0.5 kΩ, what is the mode of operation of the transistor? Verify your answer!

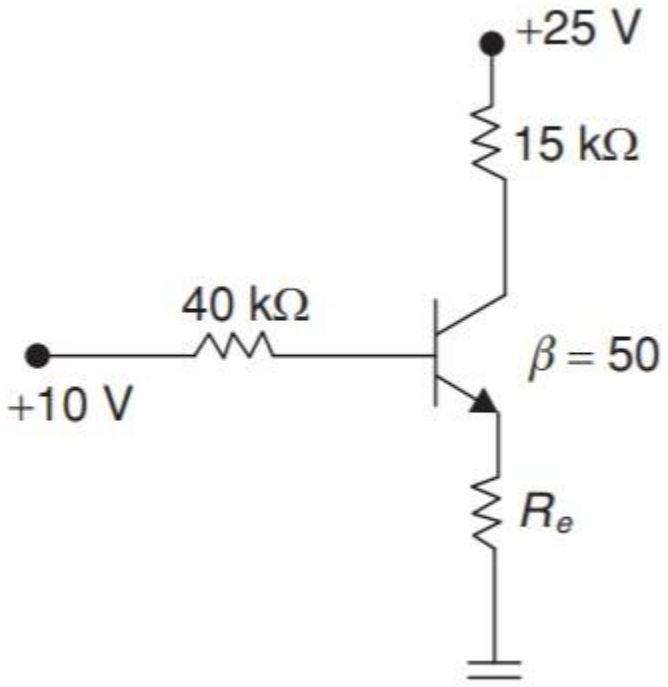

Figure 4

Problem 5:

The circuit below in Fig.5 is the hardware implementation of the combinational logic function 'C' whose inputs are signals 'A' and 'B'. If logic '1' voltage is equal to V_{CC} [V] and logic '0' voltage is 0.2 [V], then:

1. Derive the logic function truth table (binary)
2. Derive the voltage value of 'C' for all the possible input combinations. (Complete the table below as a guide and match it with the function's truth table).
3. Draw the combinational logic function 'C' circuit diagram on the gate level.

(**Note that**: the circuit parameters are: $V_{D,on}=V_{BE}= 0.7V$, $V_{BC}= 0.5V$ and $\beta=90$)

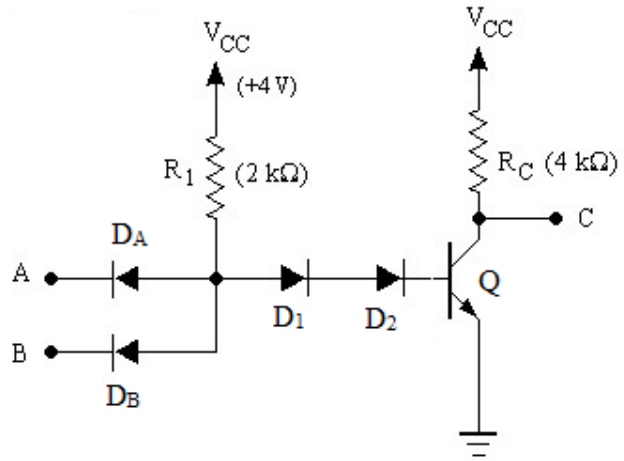

Figure 5

Input Voltage	D_A mode	D_B mode	D_1 mode	D_2 mode	Q mode	'C' Value [V]	'C' Logic Value ('1' or '0')
$V_A=V_B=0.2V$							
$V_A=0.2V$, $V_B=V_{CC}$							
$V_A= V_{CC}$, $V_B=0.2V$							
$V_A= V_{CC}$, $V_B= V_{CC}$							