Roll Number: 190070049

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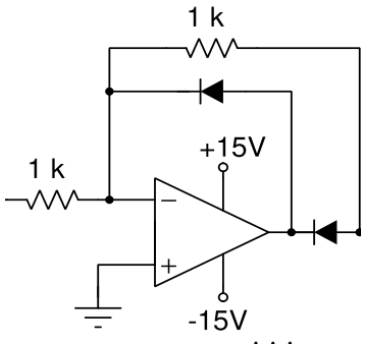
Course: Electronic Devices Lab

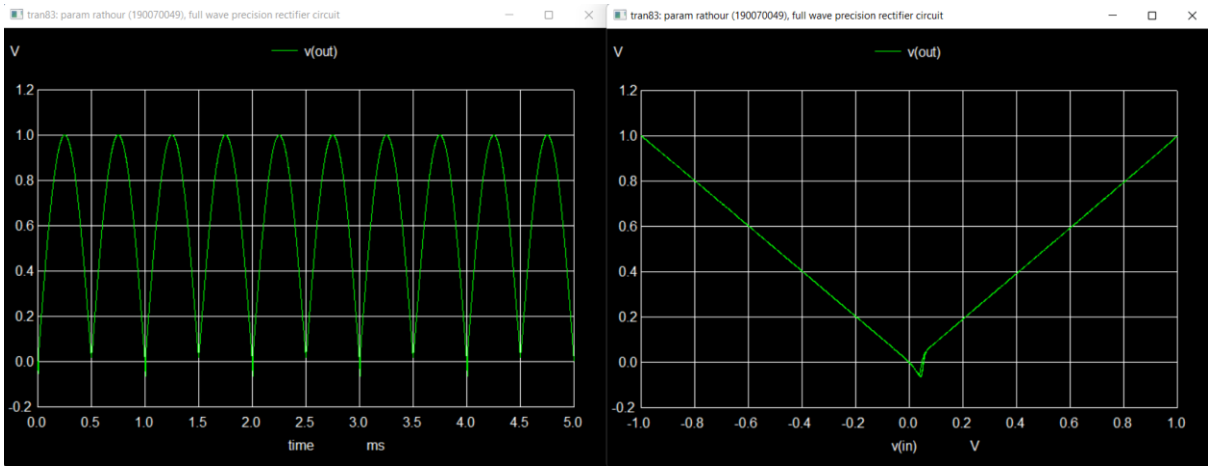
Course Code: EE236

Q1)

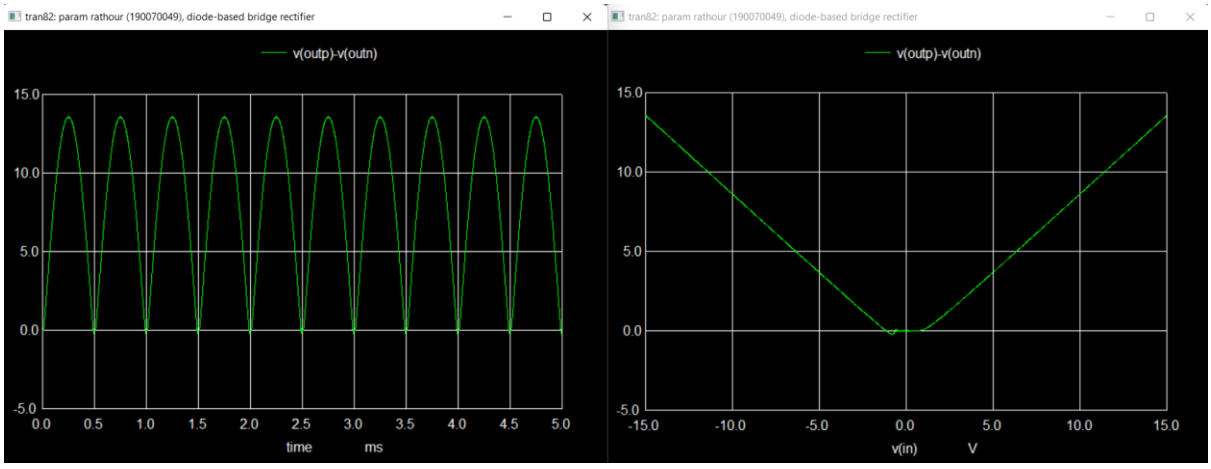
The black box is



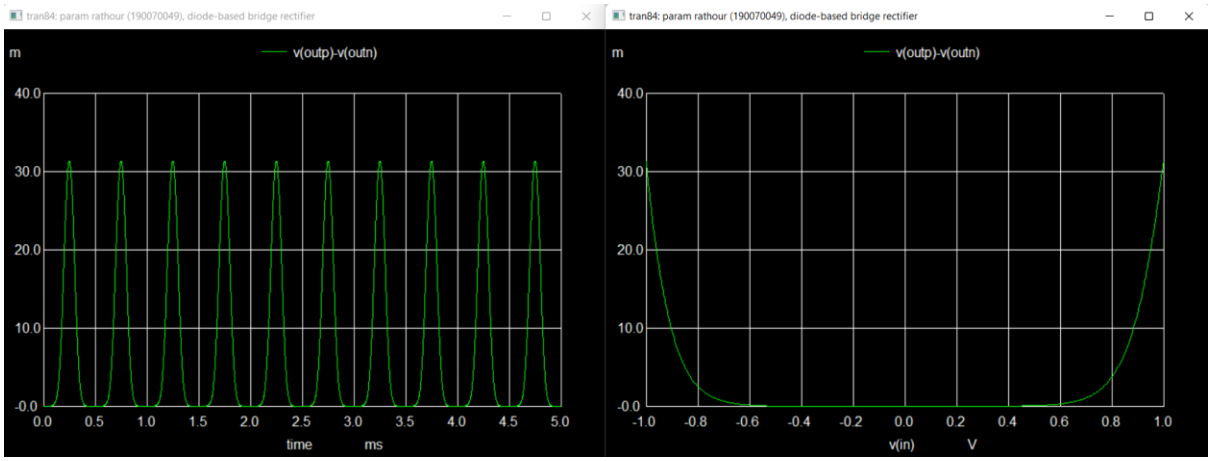
Output Response Vout and Vout vs Vin below



Full wave rectifier made using 1N4007 below (Vin =15V)



Full wave rectifier made using 1N4007 below (Vin =1V)

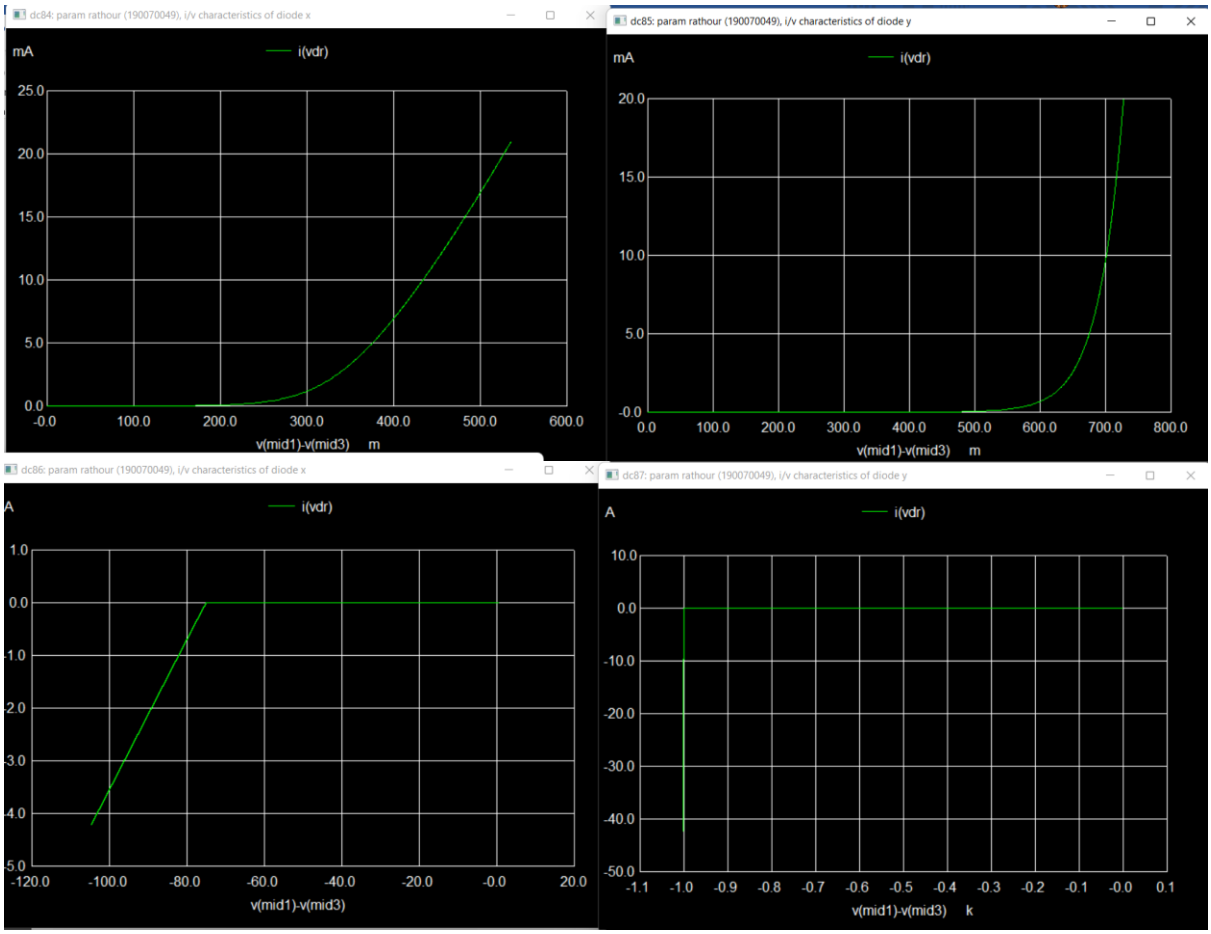


In 1N4007 (Vin =15V), the Vout vs Vin slope is less than 1 due to diode cut-in voltages, whereas in precision rectifier the slope is 1

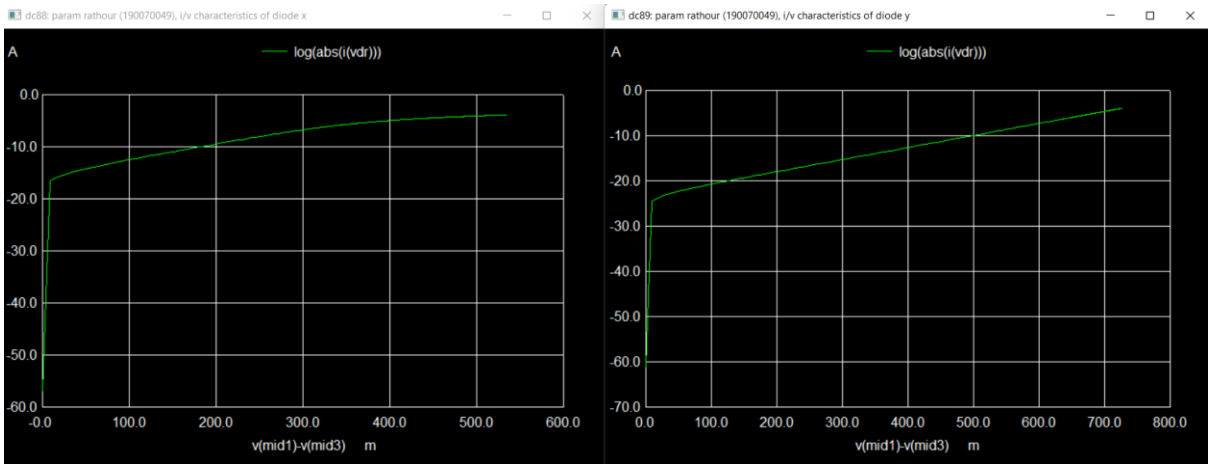
When Vin = 1V, the output is distorted for 1N4007 due to diode cut-in voltages

Around Vin = 0V, 1N4007 is flat and precision is sloped slower (response due to high frequency)

Q2) I-V characteristics of X, Y



log I-V characteristics of X, Y



Using the above,

$$\text{slope} = \frac{\ln I_{D_2} - \ln I_{D_1}}{V_{D_2} - V_{D_1}} = \frac{1}{\eta V_T} \rightarrow \eta = \frac{1}{V_T}\left(\frac{V_{D_2} - V_{D_1}}{\ln I_{D_2} - \ln I_{D_1}}\right)$$

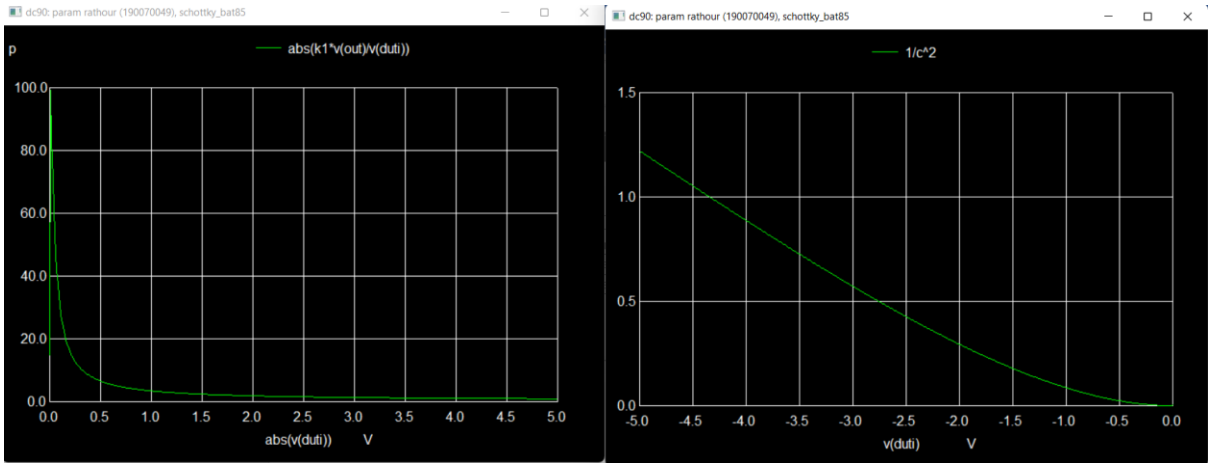
$$I_S = \exp\left(\text{y-intercept}\right)$$

Diode X can be used when for power rectifiers as it has lower forward voltage and higher ideality factor.

Diode	Forward Voltage (approx) (in mV)	Reverse Saturation Current (in A)	Peak Inverse Voltage (PIV) (in V)	Ideality factor
X	209.6655	2.095383e-07	-74.8272	1.336854
Y	527.9265	6.904011e-11	-1000.15	1.423315

By comparing their forward voltages, X is probably Germanium diode and Y is Silicon.

Q3) C_DUT vs |V_DUT| and 1/C^2 vs V_DUT are plotted respectively



The CDUT vs |VDUT| characteristics looks like a hyperbola and that is actually the case as can be seen from first formula

$$|V_{out}/V_{DUT}| = (C_{DUT}/C_{fb})(1/\sqrt{1 + 1/(\omega.R_{fb}.C_{fb})^2})$$

1/C^2 vs V_DUT plot is approximately a straight line. Hence,

Slope of 1/C^2 vs V_DUT = (8.869170e-01 - 2.937230e-01)/(-4-(-2)) = -2.96597

N_D = 4.08661e+21 atoms/cm^3 was calculated using K2, slope of 1/C^2 vs V_DUT

V_bi = 17.04114mV using y-intercept of 1/C^2 vs V_DUT, N_D and K2

where K2 = $(2/q\varepsilon N_D)$