EE 380: EC LAB EXAM (Monday - slot1 10th Nov)

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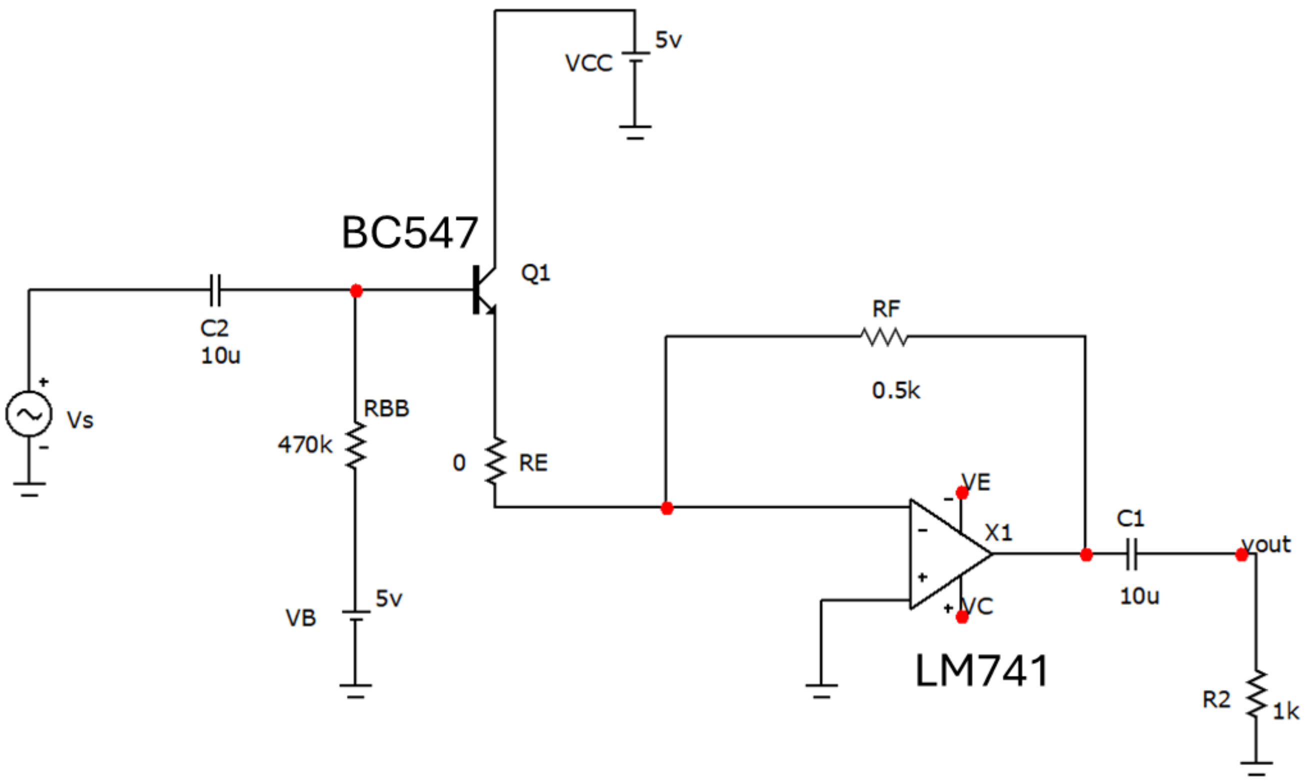
Roll No : 230875 **Time : I hour 30 min**

There are 4 parts of this exam . Document all the results and show results of part-1 and part-3 to the instructor (not TA) for verification before recording it in answer book. No marks will be given for these results if they have not been verified. All results have to be entered in this file only and final file uploaded on MooKit in pdf format. File name should be your roll number. All parts have to be done using the computer in the lab. **Personal laptops are not allowed**. Other than Mookit, internet access of any kind will be considered use of unfair means and penalized accordingly.

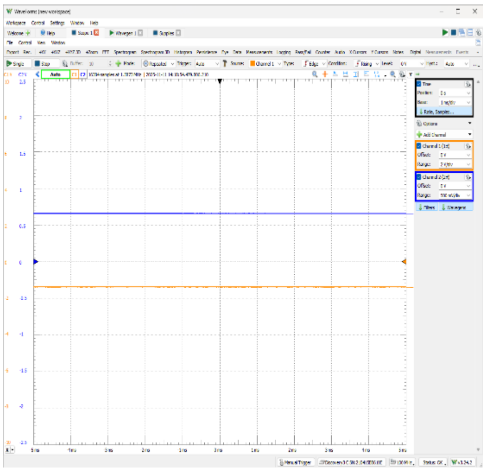
Part-1

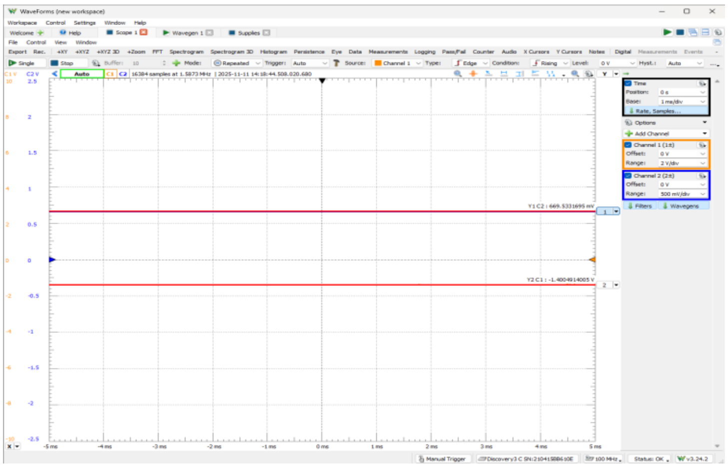
Breadboard the circuit shown and use it to determine current gain (β) and ac transconductance g_m for $v_s = 10mV\ Sin(\omega t),\ f = 1kHz.$ **Note** $\boldsymbol{R_E = 0}$ **initially.** Use 741 opamp and power supplies of ±5V.



Answer-1

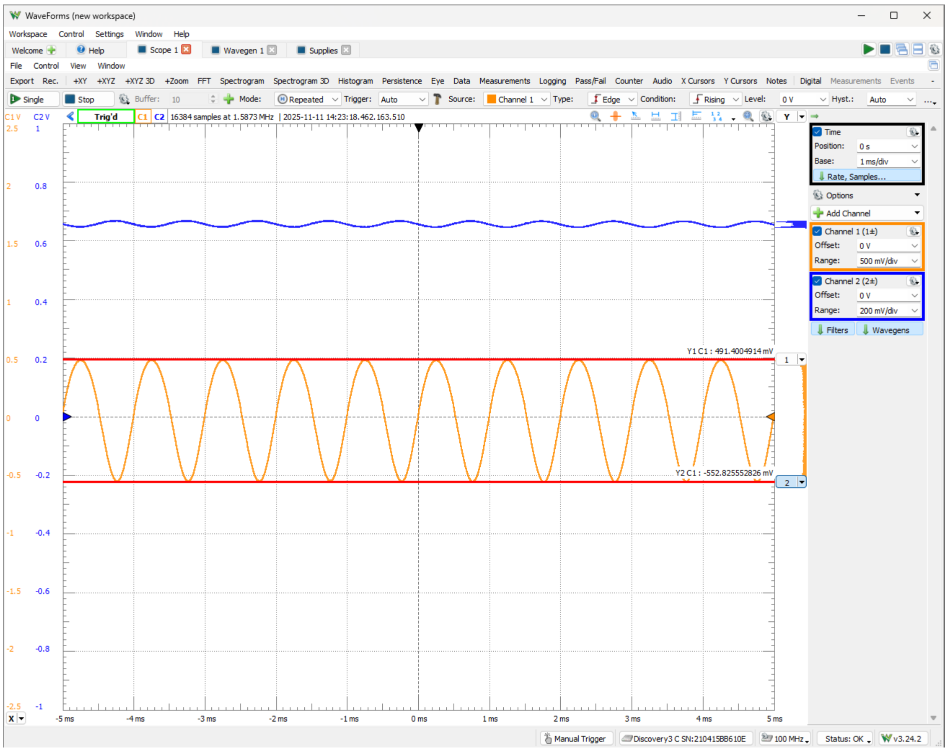
Show the results to the instructor first and then take a screenshot of your results and paste it in the space below. Insert any many pages as you require





Base potential VB = 0.67V, So the base current IB = (5-0.67)/470 mA = **9.2uA** Emitter current is measured via Vout so IE = (-Vout)/0.5 mA = 1.4/0.5 mA = **2.8mA**

So β = IE/IB – 1 = 2800/9.2 – 1 = 303 so, $\boldsymbol{\beta}$**=303**



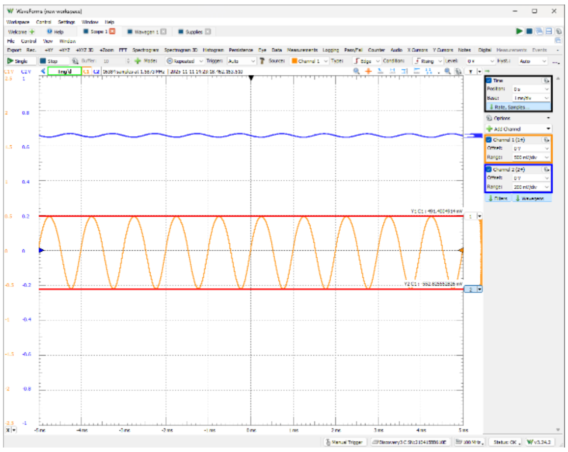
Transconductance g_m= del(IC)/del(VB) = del(Vout)/(500*del(VB)) = 1.04/(500*0.02)

g_m**=0.104 S**

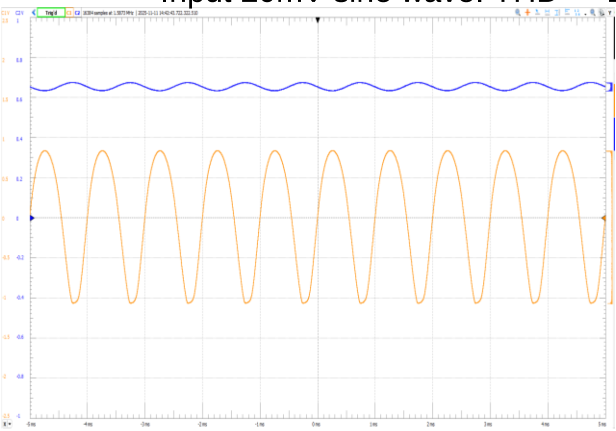
Part-2

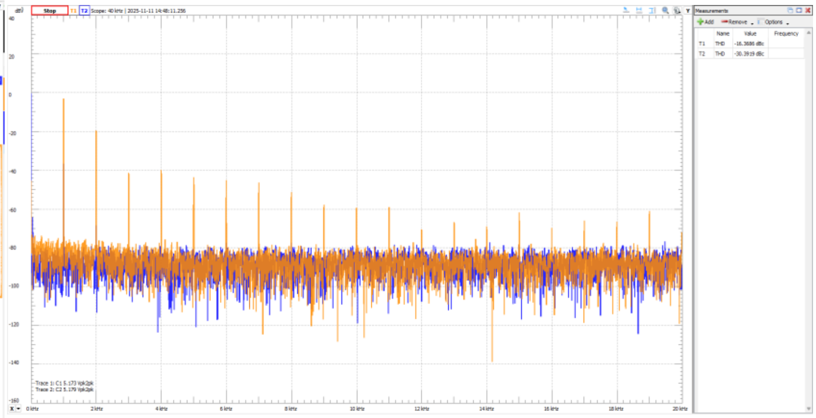
Measure distortion in the output ac voltage as a function of input ac voltage and explain the observed trend . Paste relevant screenshots and explain the data.

Input 10mV sine wave. THD = -21.6dB

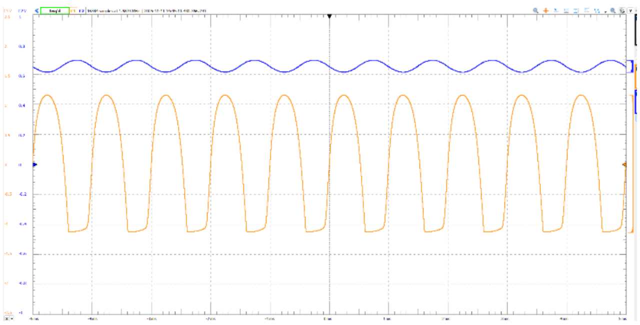


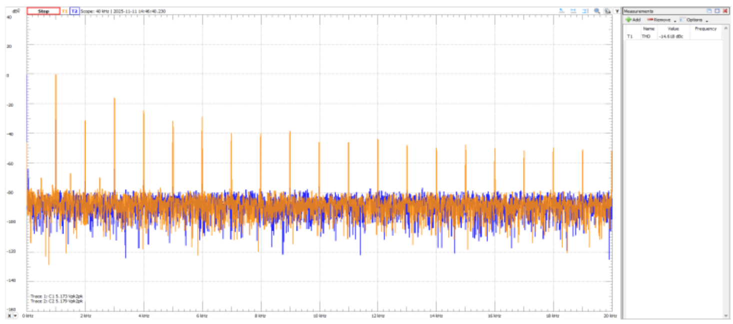
Input 20mV sine wave. THD = -16dB





Input 40mV sine wave. THD= -14.6dB



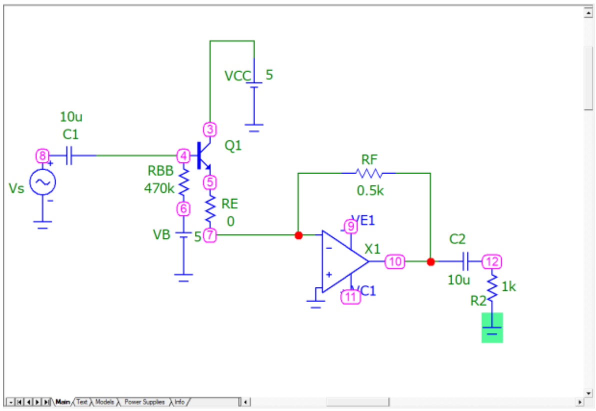


Ideal sine wave has a THD = -30dB, and from the plots it is clearly visible that as the input Voltage increases, the output is more distorted and it contains more amount of 2^{nd}, 3^{rd} ….. harmonics, hence the total harmonic distortion also increase.

Part 3

Simulate the circuit in MICROCAP to obtain results described in part-1. Paste relevant simulation plots.

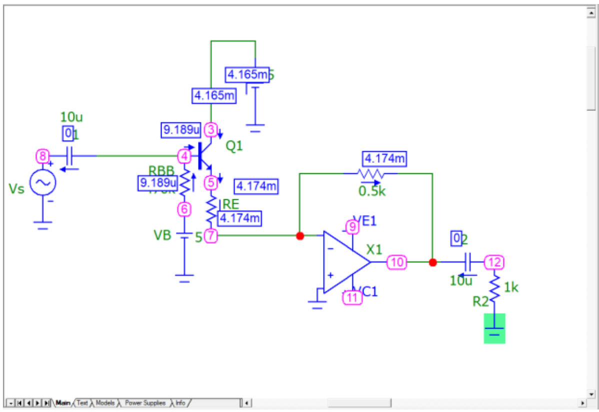
Microcap simulation results



Using the dynamic DC analysis IC and IB can directly be obtained as shown below

β = IC/IB = 4.165mA/9.189uA = 453.3

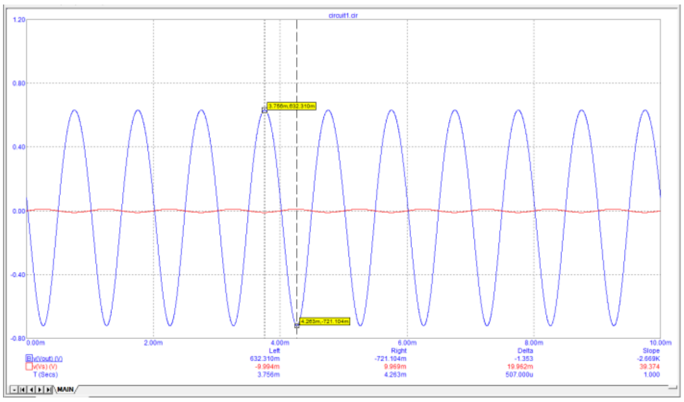
So $\boldsymbol{\beta} = \mathbf{453.3}$



By doing transient analysis we can calculate for g_m g_m= del(IC)/del(VB) = del(Vout)/(500*del(VB))

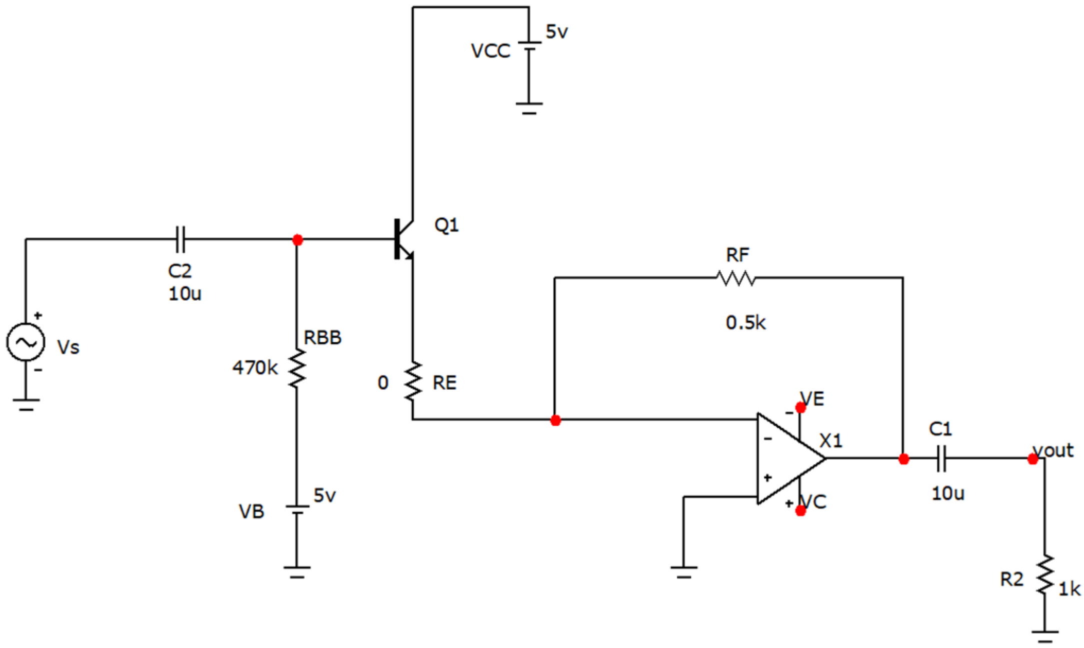
= 1.353/(500*0.02) = 0.135 S

So, $\boldsymbol{g_m}$**= 0.135 S**

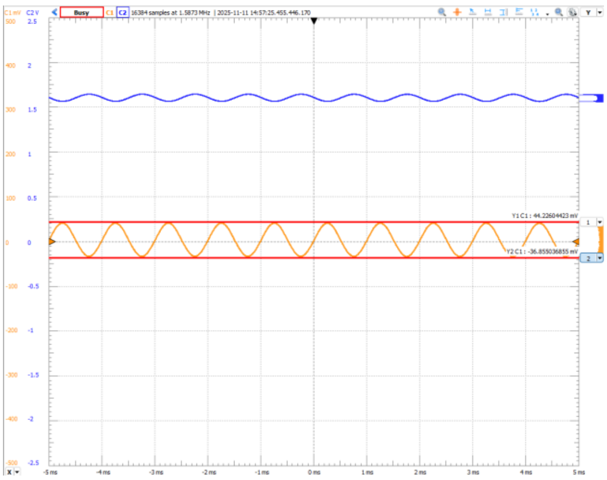


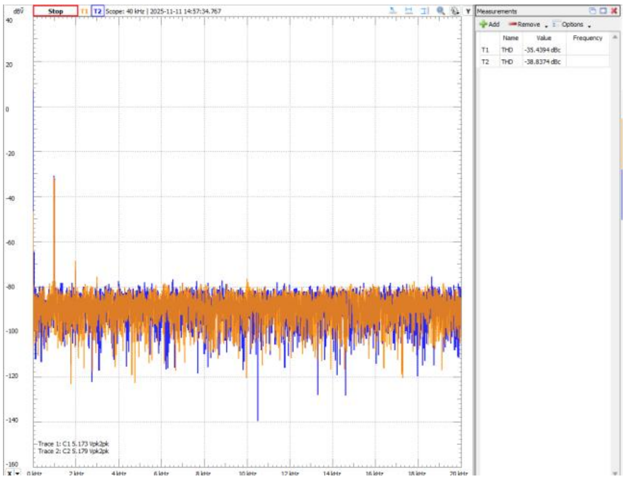
Part-4

After completing parts 1-3, experimentally determine the impact of resistance RE on transconductance and distortion. Paste relevant results



1) RE = 510 ohms, input: 40mV sine wave

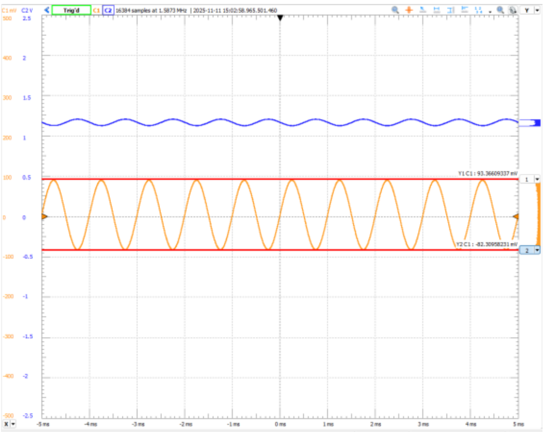


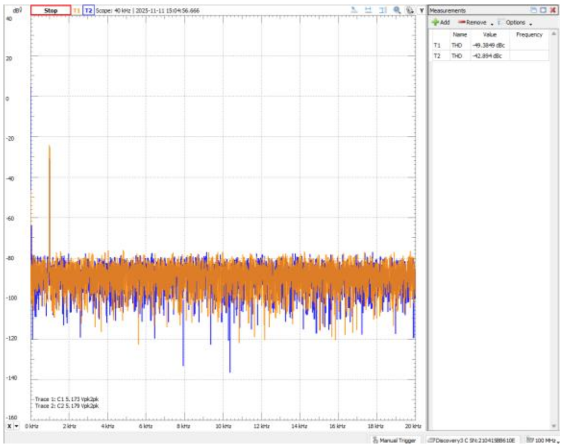


g_m= del(IC)/del(VB) = del(Vout)/(500*del(VB)) = 0.08/(500*0.08) = 2mS

g_m= 2mS

2) RE = 220 ohms, input : 40mV sine wave





g_m= del(IC)/del(VB) = del(Vout)/(500*del(VB)) = 0.175/(500*0.08) = 4.375mS

g_m= 4.375mS

so as, we increase RE, the gain decreased and hence the output had less distortions, as can be seen from the respective THDs