EEE 51 Assignment 1

2nd Semester SY 2018-2019
Due: 5pm Tuesday, January 29, 2019 (Rm. 220)

Instructions: Write legibly. Show all solutions and state all assumptions. Write your full name, student number, and section at the upper-right corner of each page. <u>Start each problem on a new sheet of paper</u>. Box or encircle your final answer.

Answer sheets should be color coded according to your lecture section. The color scheme is as follows:

THQ	–	yellow
THU	–	white
WFX	–	pink

1. **BJT DC Biasing**

   For Figure 1, use the following values: $R_1 = 135k\Omega$, $R_2 = \infty$, $R_C = 800\Omega$, $R_E = 0\Omega$, $I_s = 100fA$, $V_A = \infty$, and $\beta = 120$
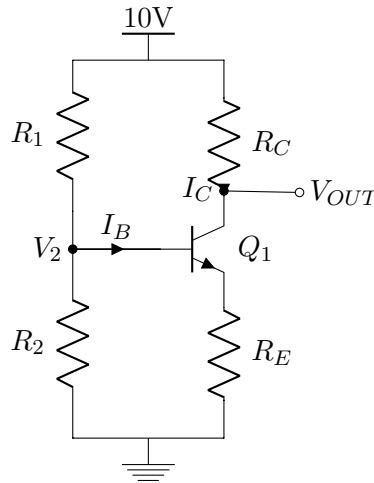

Figure 1: BJT Circuit

   (a) Find the base-emitter voltage, V_{BE}, the collector current I_C, and V_{OUT} at T=300K (*3 points*)
   (b) Suppose R_E is 200Ω and R_2 is finite but has an unknown value
       i. Find the collector current I_C such that $V_{OUT} = 5V$ (*2 points*)
       ii. Find the base-emitter voltage V_{BE}, and the base current, I_B (*2 points*)
       iii. Compute for the voltage across the unknown resistor, V_2 (*1 point*)
       iv. Compute for the value of the unknown resistor R_2 (*2 points*)

2. **MOSFET DC Biasing**

   Shown in Figure 2 is an NMOS circuit with Drain, Source and Load Resistance R_D, R_S, R_L. It is supplied by both positive and negative supply $V_{DD} = 0.8V$ and $V_{SS} = -0.8V$. The NMOS has the following parameters which are $k = 100\mu A/V^2$, $V_{TH} = 0.2V$, $\lambda = 0$.
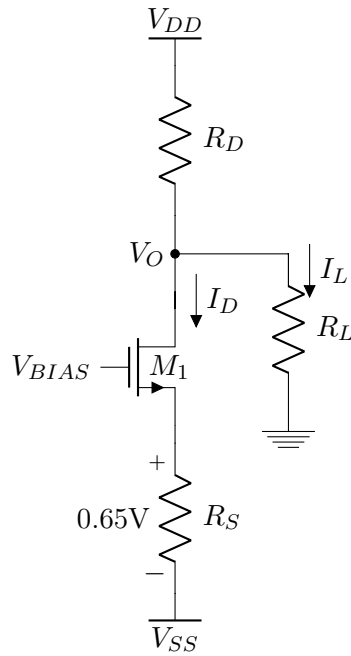
Figure 2: MOSFET Circuit

Suppose $V_{BIAS} = 0.65V$, $I_L = 20\mu A$, and $R_D = 5k\Omega$

(a) Find V_{GS} (*1.5 points*)

(b) Find I_D. State all necessary assumptions. (*2 points*)

(c) Find V_{DS} of M_1 (*1.5 point*)

(d) From (a) to (c), is M_1 in saturation or in linear mode? State and verify the condition for the chosen mode of operation. (*1.5 points*)

(e) Find V_O (*1.5 points*)

(f) Find R_S and R_L (*2 points*)

TOTAL: 20 points.