EE342 – Electronics I
Exam I

Date: 10/8/2008
Name: ___________________________

Open text, closed notes.
To receive partial credit you must show all work and you must work neatly!

1. [24%] Find the values of I and V for each of the circuits shown in Figure PR-1. Assume $V_{ON} = 0.6 \text{ V}$ and $R_f = 0 \text{ \Omega}$.

(a) $I = \ldots \ldots$, $V = \ldots \ldots$

(b) $I = \ldots \ldots$, $V = \ldots \ldots$

(c) $I = \ldots \ldots$, $V = \ldots \ldots$

Figure PR-1
2. [24%] Consider the diode clipper circuit shown in Figure PR-2. Assume that the voltage drop across all forward biased diodes is a constant 0.6 V (R_f = 0 Ω). What is the current, I, when V_in is equal to (a) +10 V, (b) 0 V, (c) –10 V? (d) Sketch the input/output characteristic (V_out versus V_in) for −10 V ≤ V_in ≤ +10 V on the provided grid. Clearly indicate the values of (V_in, V_out) at the transition points on the I/O characteristic.

(a) I (V_in = +10 V) = ___________________

(b) I (V_in = 0 V) = ___________________

(c) I (V_in = –10 V) = ___________________

(d) Sketch the I/O characteristic on the grid below (at right).

![Figure PR-2](image_url)

![Grid for part (d)](image_url)
3. [32%] For this problem refer to the Common Emitter amplifier shown in Figure PR-3. Assume $V_{BE} = 0.7$ V and $\beta = 100$. Find the following (a) $V_{BE}$, (b) $R_B$, (c) $I_{BQ}$, (d) $I_{CQ}$, (e) $I_{EQ}$ and (f) $V_{CEQ}$. (g) What is the maximum symmetrical swing in the collector current for this circuit? (h) What is the corresponding maximum symmetrical swing in the output voltage?

(a) $V_{BB} =$ ________________
(b) $R_B =$ ________________
(c) $I_{BQ} =$ ________________
(d) $I_{CQ} =$ ________________
(e) $I_{EQ} =$ ________________
(f) $V_{CEQ} =$ ________________
(g) $i_{c,\text{max}} =$ ________________
(h) $v_{out,\text{max}} =$ ________________

Figure PR-3
4. [20%] The circuit shown in Figure PR-4 is to be used to interface a microcontroller to a 12 V, 100 mA DC motor. The microcontroller operates from a 5 V supply and can source up to 2 mA from a HI (4.2 V) output and can sink up to 20 mA into a LO (0.2 V) output. The transistors should be switched between cutoff and saturation when the microcontroller output (v_in) changes state. The data sheets for the 2N3904 and 2N3906 transistors can be found on pages 929 and 935 of your text. Assume that, when the NPN transistor is in saturation, V_{BE} = 0.7 V and V_{CE} = 0.2 V (for the PNP transistor, the values are V_{EB} = 0.7 V and V_{EC} = 0.2 V). Find the values of R_1 and R_2 so that the circuit operates correctly. Find I_1 and I_2 when the motor is running.

(a) R_1 = ________________

(b) R_2 = ________________

(c) I_1 = ________________

(d) I_2 = ________________

Figure PR-4