SEVENTY-FIVE MINUTES. CLOSED BOOK. ANSWER ALL QUESTIONS.
ONE: 8-1/2” × 11” SHEET OF NOTES ALLOWED.

Figure 1
1. (30 points) In Figure 1, Q1 and Q2 are n-channel enhancement type MOSFETs, and Q3 and Q4 are p-channel devices. Logical “0” 0.0 volts. Logical “1” is near the supply voltage.

   a. Make a table showing the states of Q1, Q2, Q3, and Q4 ( “ON” or “OFF” ), and X ( 0 or 1 ) as a function of the logic values of inputs A and B.

   b. Find the logical relation between A, B, and X, e. g. XOR, AND, etc.

Figure 2
2. (40 points) The circuit shown in Figure 2 uses edge-triggered D-type flip flops. The clock frequency is 1.0 MHz.

   a. Draw a complete state diagram for the circuit, in terms of the binary state Q1Q0.

   b. Find the frequency of the waveform at Q0.

   c. Find the percentage of time that Q0 is a logical “1”.

Figure 3
3. (30 points) The circuit shown as Figure 3 uses an NPN bipolar junction transistor.

   a. Find the base current.

   b. Find the collector voltage.

   c. Is the transistor cut-off, saturated, reversed, or active?