1. (a) FET Flip Flop
   2 pts
   \[ \text{IDS} = K[(V_{GS} - V_T)V_{DS} - V_{DS}^2]/2 \]; \( K = 1 \text{mA/V}^2 \); \( V_T = 1 \text{V} \).
   a) Determine the value of VOL (just do one iteration).
3)  Bistable Multivibrator
Plot the waveforms of the listed nodes showing voltage levels, times, and time constants for the applied input pulse to the circuit shown.
Assume Q1 on to start
a) $V_k$ 1 pt
b) $V_{be1}$ 1 pt
c) $V_{ce1}$ 1 pt
d) $V_{be2}$ 1 pt
e) $V_{ce2}$ 1 pt

4) S C Bistable 4 pts.
a) Build a clocked SC Flip Flop out of nand gates, show the circuit
b) Build a clocked SC master-slave Flip Flop employing nand gates
   show the circuit.
For the circuit shown: Plot $V_{o1}$ and $V_{o2}$ for the applied number of
   clock pulses.

8' A to D Converter 4 pts.
1 following circuit converts an analog input from 0 to 10V to a digital
BISTABLE MULTIVIBRATOR (D Flip Flop)

student connects three D flip flops and a NAND gate together to form a Counter, which represents the following equations:
D2=Q1; D3=Q2; D1=Q1+Q2.
a) Draw the block diagram circuit starting with FF1 on the left.
   With the aid of a NAND gate truth table draw the state transition diagram showing all eight states.
c) What type of counter is this?
d) Is the counter self starting and WHY?

6. IFF

The switch is normally OPEN, after 10 us the switch is CLOSED for 10 us and then OPENED again. Demonstrate the operation of the circuit by:

a) Plotting on the same page Vc, VBE1, VCE1, VBE2, VCE2, 3 pts
b) After what length of time of keeping the switch closed will the state of the flip flop be unpredictable. 1 pt
For the following circuit:
RC1=RC2=1000, RB11=RB21=20K, RB12=RB22=30K, C1=C2=2000pF, C3=1000pF

Plot the following plots show all voltage levels, times, and time constants for the applied input.

a) Determine the two time constants (one for positive input transitions and the other for negative transitions) of the input differentiator ckt. 1 pt. assume C1 and C2 are very large for this calculation and Forward resistance = 0 for D1 and D2 Forward resistance = 100 ohms for D3

b) Plot the node voltage at the K node of the circuit. 1 pt.

c) Plot the node voltage at the base of each transistor. 2 pts.

d) Plot the node voltage at the collector of each transistor. 1 pts.