(1) Explain the following terminology in the sense of Logic Design:

(a) Finite State Machine. (2%)

(b) Flip-flop. (2%)

(c) Hazard. (2%)

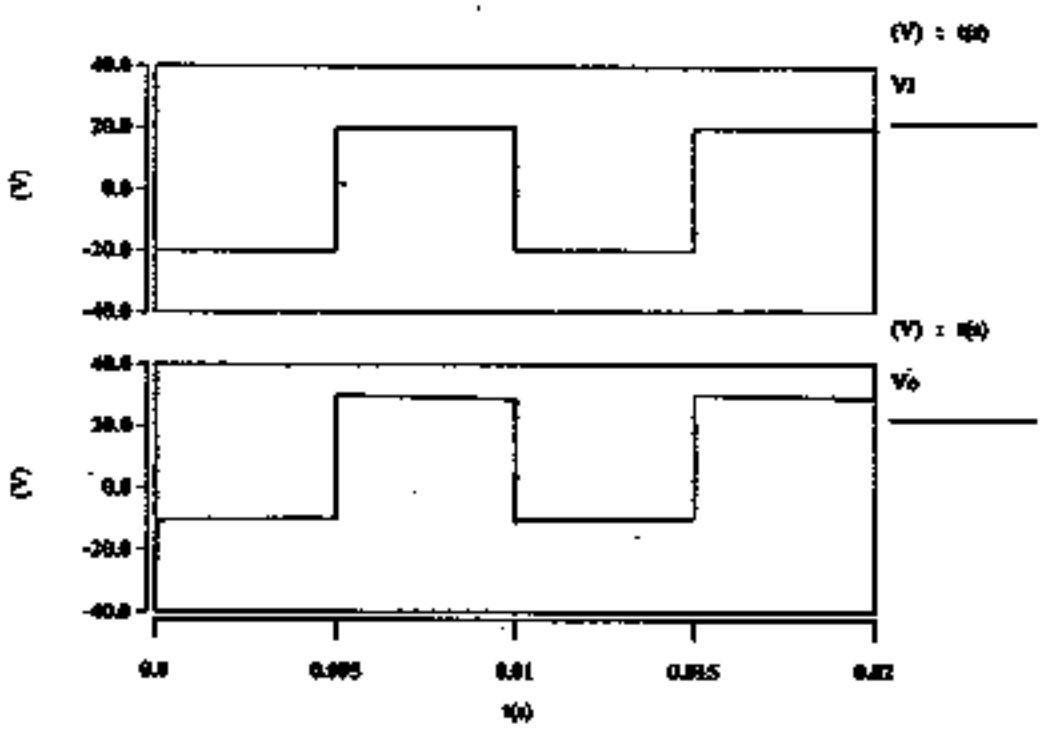
(d) Sequential Logic. (2%)

(2) Based on the terminological words in the following items from (a) to (j), please choose the closest descriptions numbered from (1) to (10). (10%)

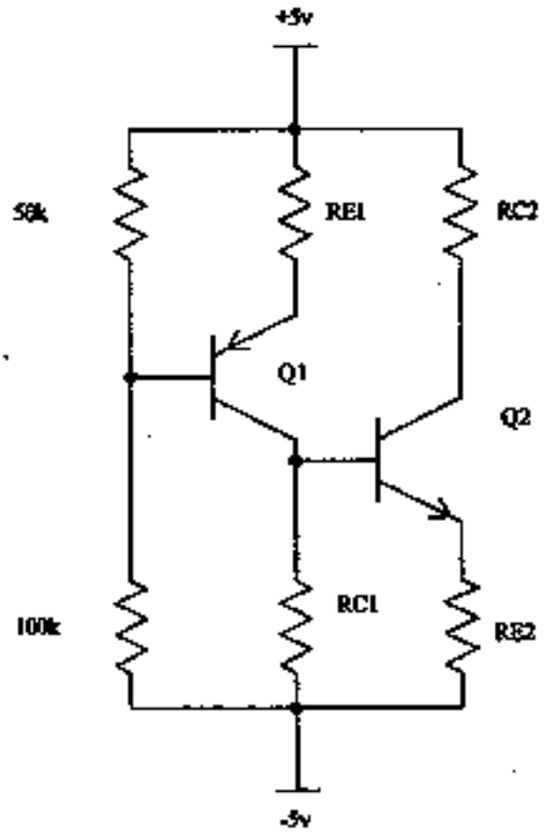
(a) Photo diode.
(b) Diffusion current.
(c) Emitter follower amplifier.
(d) Early effect.
(e) Darlington transistor.
(f) CMOS technology.
(g) Common rejection.
(h) Instrumentation amplifier.
(i) Miller capacitance.
(j) Pinch-off effect.

(1) Using p and n channel on the same wafer.
(2) With very large impedance on both inputs.
(3) Provide super high current gain.
(4) Parasitic capacitance between B and C.
(5) Controllable reverse junction current.
(6) Contribute to the output resistance.
(7) Voltage gain is smaller than unity.
(8) Controlled by gate voltage level.
(9) Due to difference in carrier concentration.
(10) Ability to reduce common mode signals.

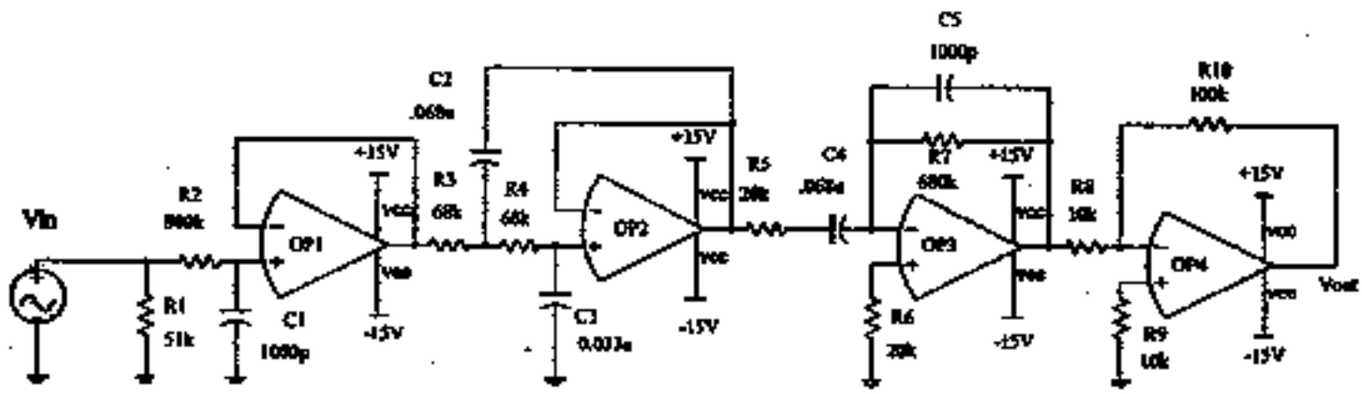
(3) Design a diode clamper to generate the output V_o from the input V_i as shown in the following plots if the $V\gamma$ of the diode is assumed to be 0 volt. **Hint: the circuit must have a diode, a capacitor, a resistor, and a voltage source.** (10 %)



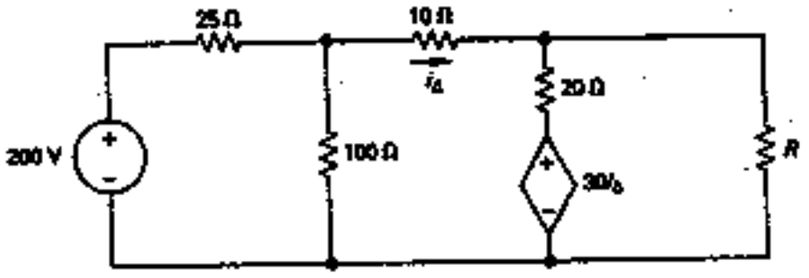
(4) For the transistor amplifier shown in the following figure, the parameters of the transistor are: β=100, $V_{BE(on)}=V_{EB(on)}$=0.7 V. Determine the R_{C1}, R_{C2}, R_{E1}, and R_{E2} such that $I_{C1}=I_{C2}$=1 mA and V_{CEQ1}=3.5 V and V_{CEQ2}=4.0 V. (10 %)



(5) For the given signal conditioning circuit based upon four operational amplifiers (OP), (a) please describe the function of each OP in the circuit. (8%) (b) What is the transfer function of the given circuit ? (2%) **Hint: you can guess it by making use of reasonable assumptions.**



(6) When an ammeter is used to measure the current through the resistor R = 2 Ω in the circuit shown in the following figure, it read 10 A. What is the resistance of the ammeter? (15%)



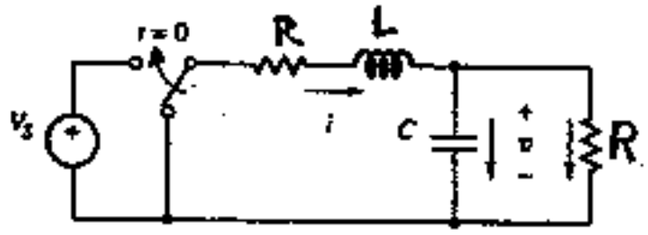
(7) The circuit shown in the following figure is in the steady state before the switch closed. Assume that there is no energy stored in the capacitor and inductor initially.

(a) Derive the differential equation for the voltage (v) across the capacitor when the switch is closed at t = 0. (5%)

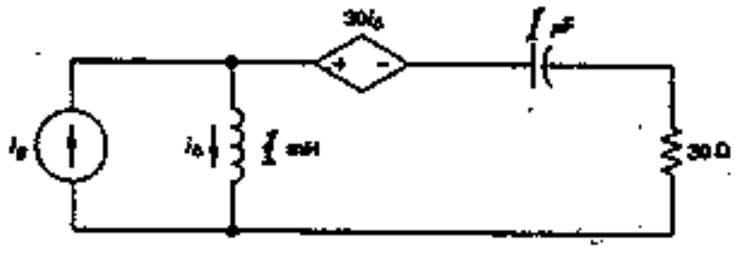
(b) Use the results in part (a), if the voltage response in the capacitor, C = 1 μF, due to the step function V_S is

$$v(t) = 5\left\{1 - Ae^{-t}\cos(t-\phi)\right\}\text{ V}.$$

Find the values of L, R, V_S, A, and ϕ (in degree).(10%)



(8) Find the average power dissipated in the 30 Ω resistor in the circuit seen in the following figure if $i_g = 10\cos(10{,}000t)$ A. (10%)



(9) Given a four-input Boolean function, $f(A,B,C,D) = \sum m(1,2,4,7,8,11,13,14)$,

(a) Minimize the product of sums form for the function. (4%)

(b) Implement the function using a 4:1 multiplexer where variables A and B are selected as the control inputs. (8%)