1. (50%) Consider the circuit shown in Fig. 1, where the load consists of a resistor and a capacitor, and the input voltage is given by

$$v_s(t) = 10\sin\omega t \quad \text{(Volt)}$$

where ω is a constant frequency to be determined.

(a) (15%) Please find the steady state voltage across the load, i.e., $v_L(t)$.

(b) (10%) We want to determine the frequency ω so that $v_L(t)$ possesses the maximum amplitude. Please give a procedure to do this. **Note:** You are NOT required to compute the correct answer. Only a procedure for this is required.

(c) (15%) Please find the average power delivered to the load, denoted by P_{AV}.

(d) (10%) We want to determine the frequency ω so that the maximum average power is delivered to the load. Please give a procedure to do this. **Note:** You are NOT required to compute the correct answer. Only a procedure for this is required.

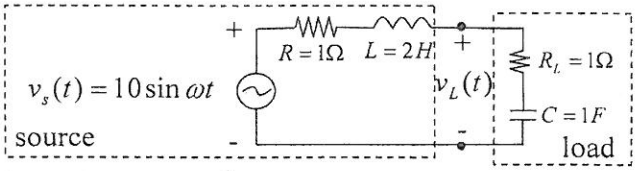

Fig. 1

2. (20%) Consider the circuit as shown in Fig. 2 below.

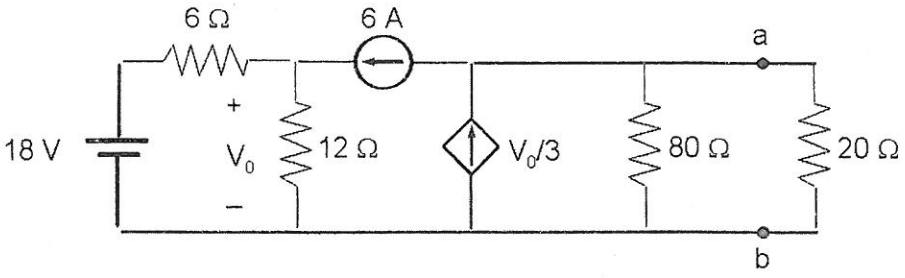

Fig. 2

(a) (10%) Determine the voltage across the 20 Ω resistor with application of superposition.

(b) (10%) Find the Thevenin equivalent circuit to the left of the terminals a and b, i.e., of the sub-circuit excluding the 20 Ω resistor.

3. (20%) Consider the Zener diode circuit as shown in Fig. 3 below. For each diode, $V_Z = 5$ V. The reverse saturation currents are 2 μA for D_1 and 4 μA for D_2.

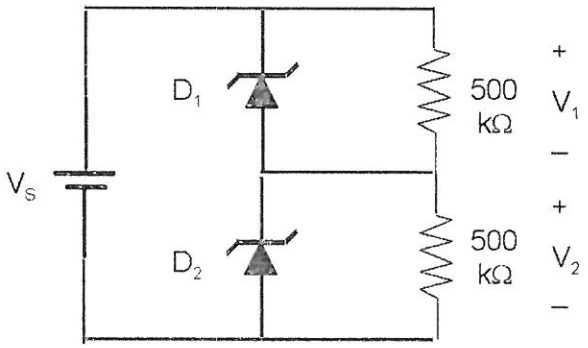

Fig. 3

(a) (10%) For $V_S = 4$ V, determine V_1 and V_2.
(b) (10%) For $V_S = 8$ V, determine V_1 and V_2.

4. (10%) Consider the TTL circuit as shown in Fig. 4 below. Discuss the logic function implemented by the circuit with inputs V_A, V_B, and V_C and output V_{out}.

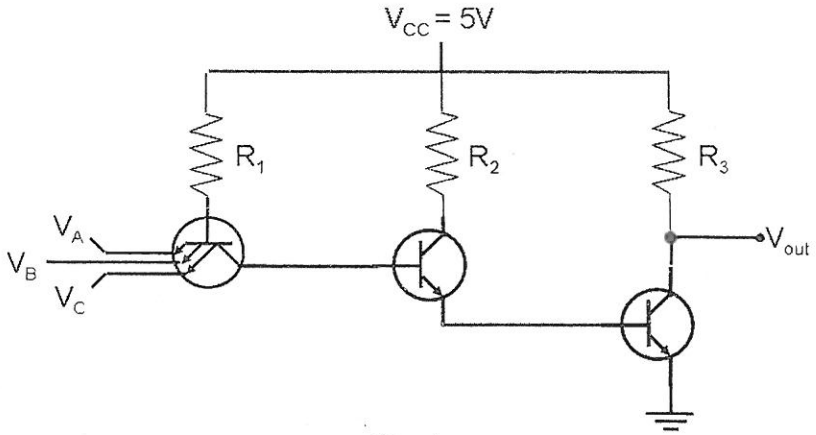

Fig. 4