

1. (a) As shown in Fig. 1, determine  $v_o(t)$ . (10%)  
 (b) What are the real power and imaginary power supplied by the current source? (10%)

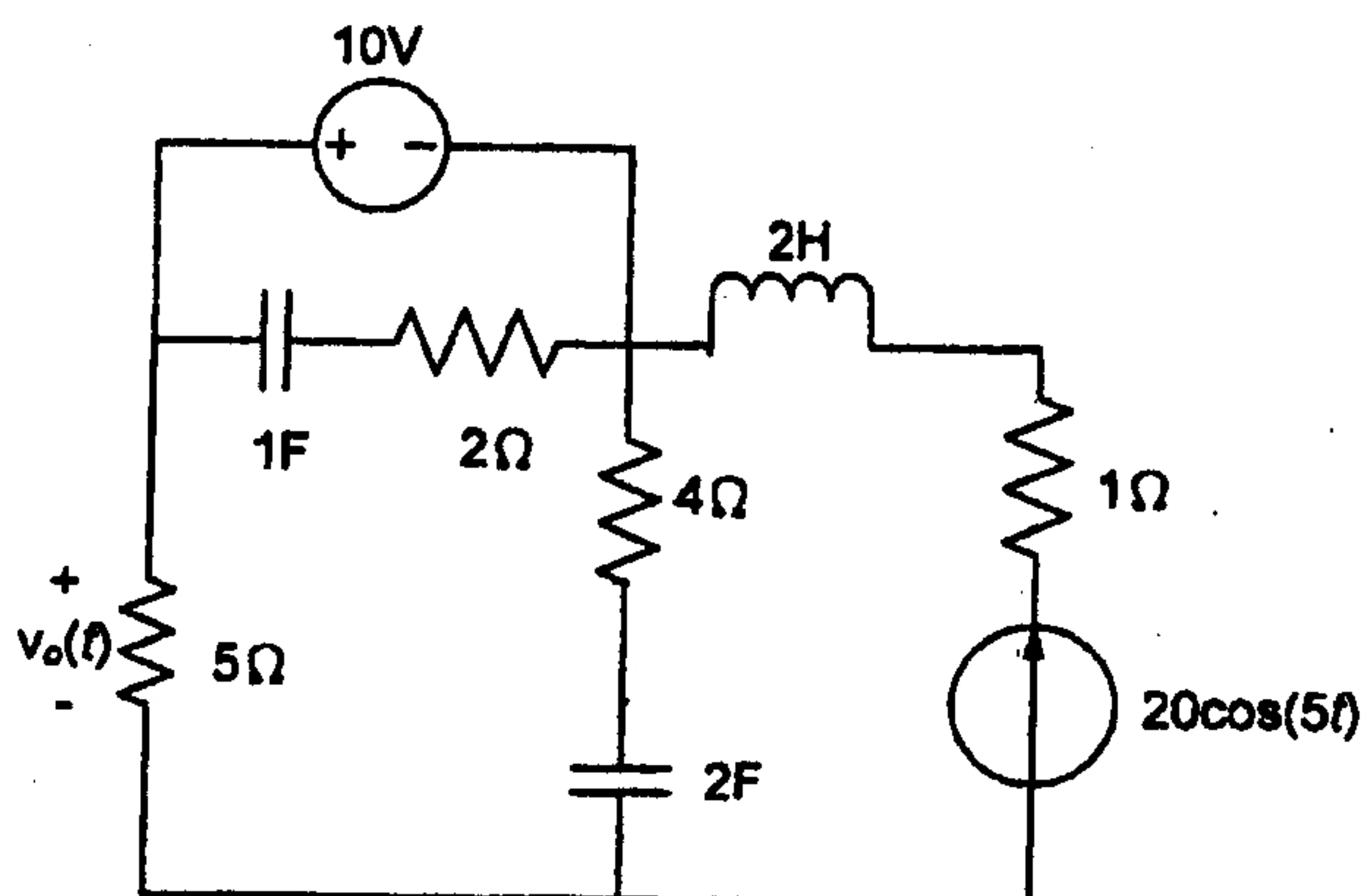


Fig. 1

2. In Fig. 2, to have maximal power transfer to the load of  $Z_L$  as shown in Fig. 2, what should the impedance of  $Z_L$  be? (15%)

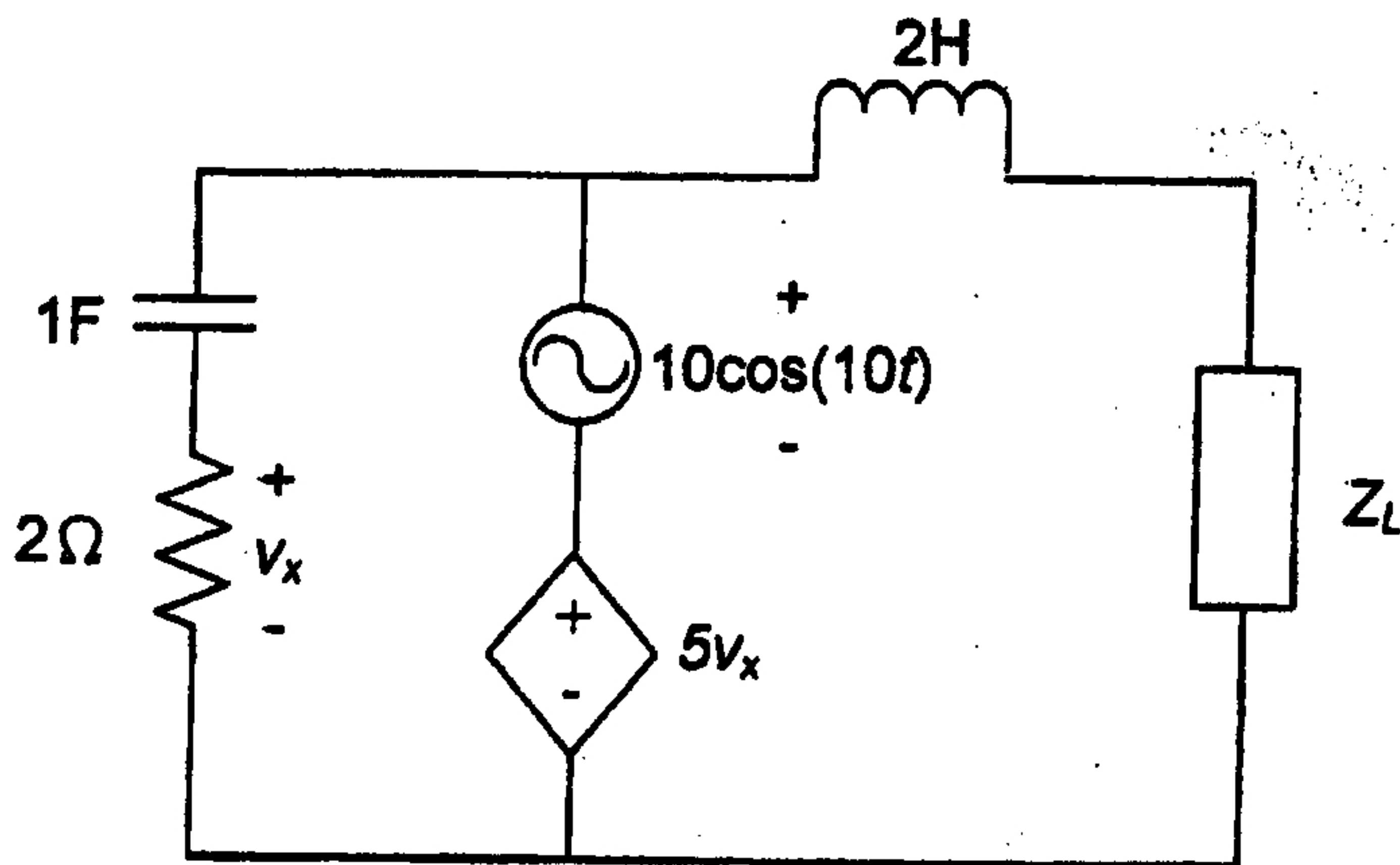


Fig. 2

(背面仍有題目,請繼續作答)

3. Assume the autotransformer as shown in Fig. 3 is ideal with a turn ratio of  $n1/n2$ . What is the transfer function  $H(\omega) = V_o/V_s$  (15%)

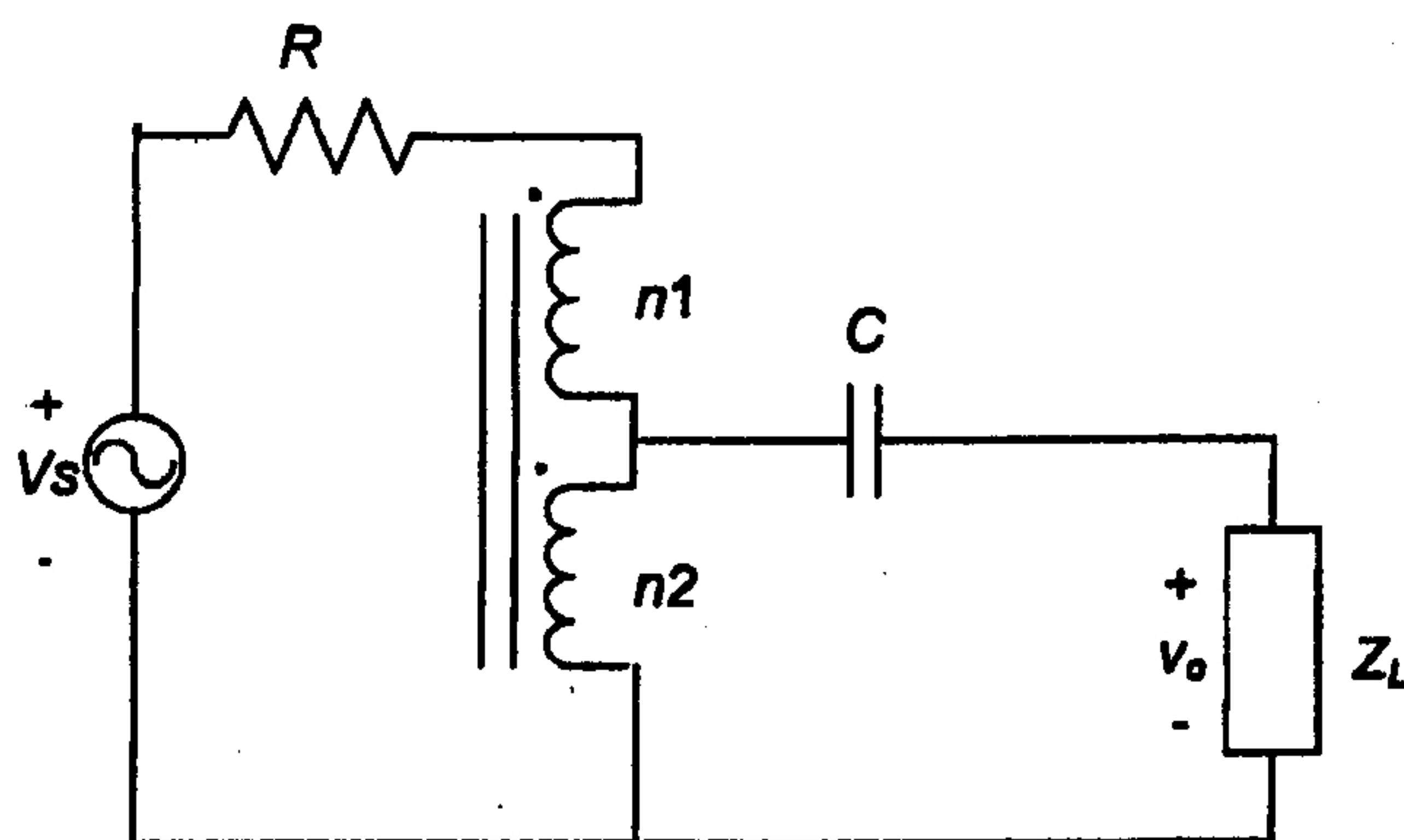


Fig. 3

4. Which statements are correct? (10%)
- A) Thevenin's theorem states that one can have a two-port circuit replaced by an equivalent circuit consisting of a voltage source in series with a resistor.
  - B) Norton's theorem, on the other hand, states that one can replace a two-port one with a current source and a resistor connected in parallel.
  - C) Suppose a Norton equivalent circuit has one 1-amp current source and  $4\Omega$  resistor connected in parallel, its Thevenin equivalent circuit would have one 4-volt voltage source connected in series with a  $4\Omega$  resistor.
  - D) One can prove Thevenin's and Norton's theorem using the superposition principle.
  - E) The maximum power can be transferred to the load from the voltage source only when the load resistance equals to Thevenin resistance as seen from the load.

5. Which statements are correct? (10%)

- A) The equivalent resistance of four  $8\Omega$  resistors all connected in parallel is equal to the equivalent resistance of three  $6\Omega$  resistors all connected parallel.
- B) The equivalent capacitance of four  $24F$  capacitors connected in series is equal to the equivalent capacitance of three  $2F$  capacitors connected all in parallel.
- C) A circuit, called CIR-X, is consisted of 3 terminals: A, B and C. Terminal C of CIR-X is connected to the ground. A  $5\Omega$  resistor, called R1, is connected between terminal A and C. A  $0.1F$  capacitor is connected in parallel with the R1. An  $8\Omega$  resistor, referred to as R2, is connected between terminal A and B. Another  $12\Omega$  resistor, R3, is in series with R2 and connected between terminal B and C. The equivalent circuit of CIR-X is one  $4\Omega$  resistor and one  $0.1F$  capacitor connected in parallel.
- D) Continued from (C). Assume the initial voltage across the capacitor of CIR-X is  $15V$  at time  $= 0$ . The response of the capacitor would be  $15e^{-2t} V$ .
- E) Continued from (D). The current passing through R3 would be  $0.75e^{-2t} A$ .

6. Given the op amp circuit shown in Fig. 4,

- A) Obtain the transfer function  $H(s) = V_o/V_s$  in the form as  $\frac{aS^2 + bS + c}{S^2 + dS + e}$ , find the value of  $a, b, c, d$ , and  $e$ . (15%)
- B) Determine whether the circuit is stable with explanation (5%)
- C) Derive the response in the  $s$  domain when  $v_s = u(t)$  (10%)

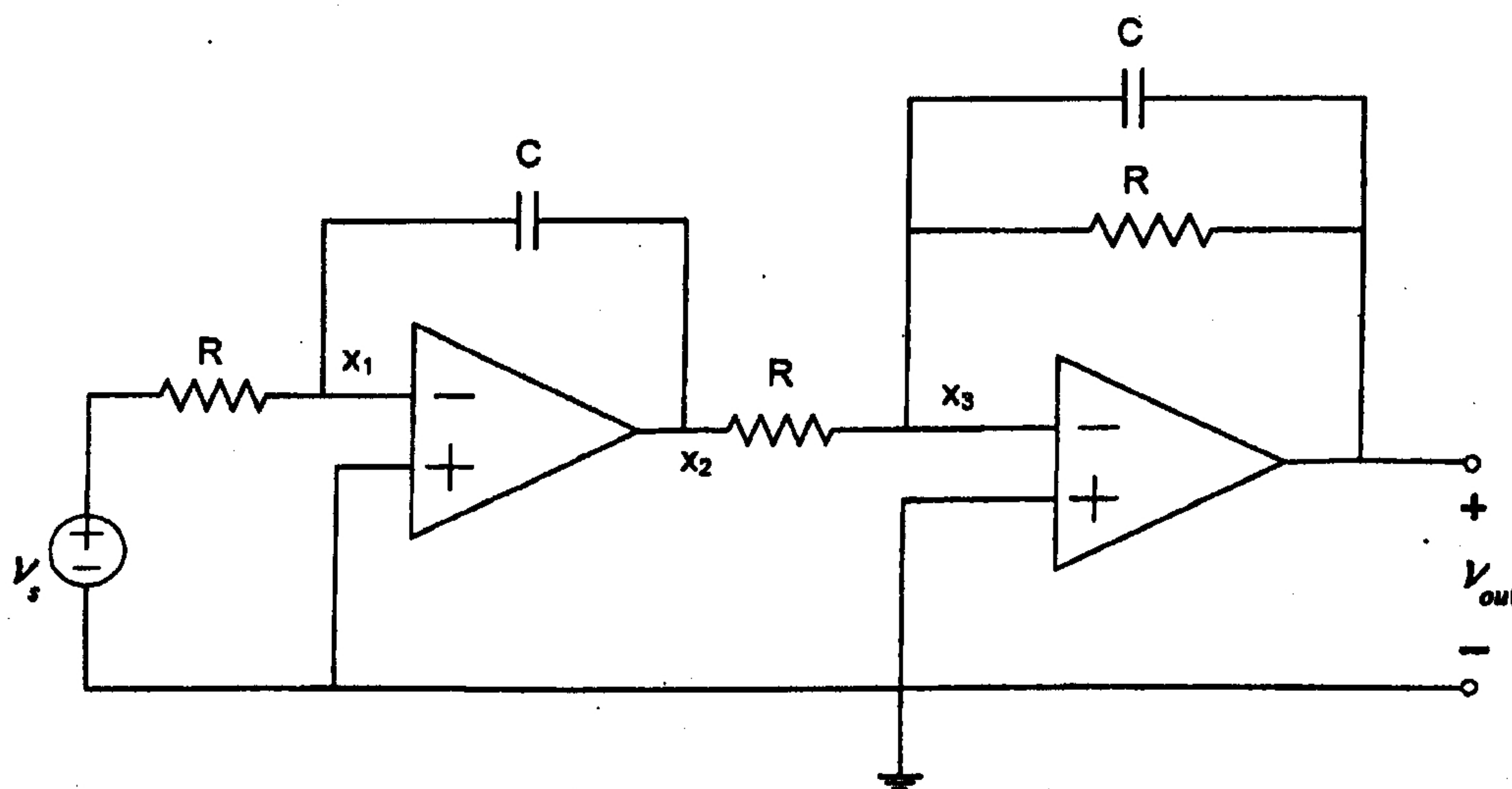


Fig. 4