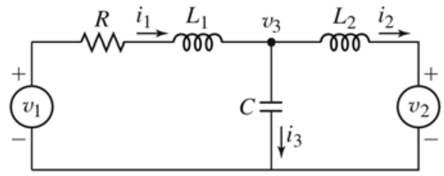
SEOUL NATIONAL UNIVERSITY
SCHOOL OF MECHANICAL AND AEROSPACE ENGINEERING

SYSTEM ANALYSIS **Spring 2015**

HW#6 **Assigned : April 14 (Tu)**
Due: April 23 (Th)

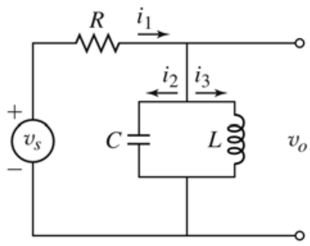
1. **For the circuit shown in Figure P6.16, determine a suitable set of state variables, and obtain the state equations.**

Figure P6.16



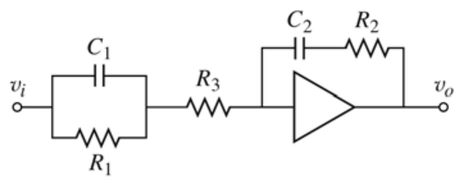
2. **Use the impedance method to obtain the transfer function $V_o(s)/V_s(s)$ for the circuit shown in Figure P6.22.**

Figure P6.22



3. **Obtain the transfer function $V_o(s)/V_i(s)$ for the op-amp system shown in Figure P6.29.**

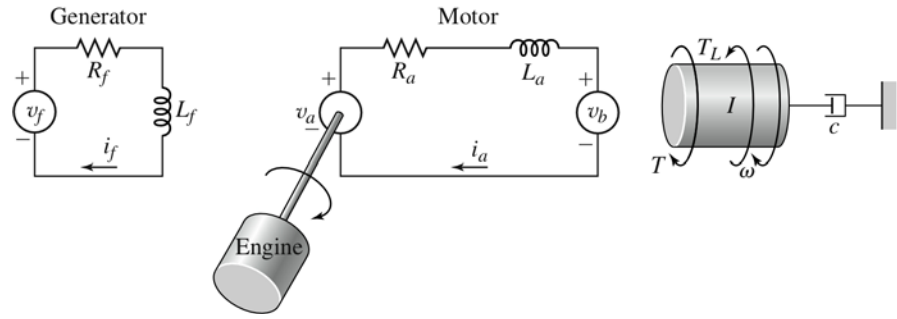
Figure P6.29



4. **Figure P6.36 is the circuit diagram of a speed-control system in which the dc motor voltage v_a is supplied by a generator driven by an engine. This system has been used on locomotives whose diesel engine operates most efficiently at one speed. The efficiency of the electric motor is not as sensitive to speed and thus can be used to drive the locomotive at various speeds. The motor voltage v_a is varied by changing the generator input voltage v_f. The voltage v_a is related to the generator field current i_f by $v_a = K_f i_f$.**

Derive the system model relating the output speed ω to the voltage v_f, and obtain the transfer function $\Omega(s)/V_f(s)$.

Figure P6.36



5. **The following measurements were performed on a permanent magnet motor when the applied voltage was $v_a = 20$ V. The measured stall current was 25 A. The no-load speed was 2400 rpm and the no-load current was 0.6 A. Estimate the values of K_b, K_T, R_a, and c.**

6. **The parameter values for a certain armature-controlled motor are**

$$K_T = K_b = 0.2 \text{ N·m/A}$$
$$c = 3 \times 10^{-4} \text{ N·m·s/rad} \qquad R_a = 0.8\ \Omega$$
$$L_a = 4 \times 10^{-3} \text{ H} \qquad I = 4 \times 10^{-4} \text{ kg·m}^2$$

The system uses a gear reducer with a reduction ratio of 3:1. The load inertia is 10^{-3} kg·m^2, the load torque is 0.04 N·m, and the load damping constant is 1.8×10^{-3} N·m·s/rad.

Use MATLAB to obtain a plot of the step response of $i_a(t)$ and $\omega(t)$ if the applied voltage is $v_a = 20$ V. Determine the peak value of $i_a(t)$.