淡江大學九十四學年度碩士班招生考試試題

系別：機械與機電工程學系　　科目：**動態系統**

准帶項目請打「O」否則打「×」
簡單型計算機
O

1. (25%) A mass-pulley system shown in Figure 1 has a rotating wheel of inertia J. Two springs and a damper are connected to the wheel using a cable without slip on the wheel. Where k_1 and k_2 are spring constants, b is the coefficient of viscous friction, d is the diameter of the wheel, x is the displacement of mass m, θ is the rotation angle of the wheel, and $u(t)$ is an input motion.
   a. Derive the force balance equation for the mass m, the moment balance equation for the wheel, and the displacement equation for x and θ.
   b. Derive the equation of motion for the system in terms of variable x and the input motion $u(t)$.
   c. Determine the natural frequency and damping ratio of this second-order system.

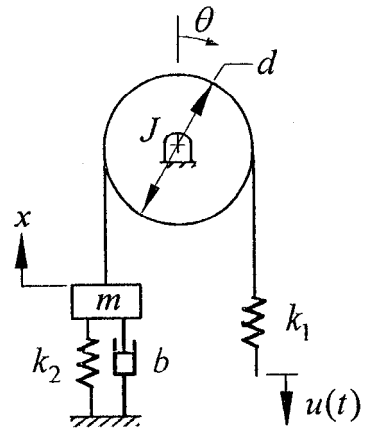

Figure 1　Mass-pulley system

2. (25%) Consider the *RLC* circuit of Figure 2, which consists of the series connection of a voltage source, $v_s(t)$, a resistor R, an inductor L and a capacitor C.
   a. Find the transfer function between the capacitor voltage $v_c(t)$ and the input voltage source $v_s(t)$.
   b. Determine the frequency response, $\frac{v_R(j\omega)}{v_s(j\omega)}$. Also calculate the resonant frequency, if R=10Ω, an inductor L=5mH, and a capacitor C=10μF.

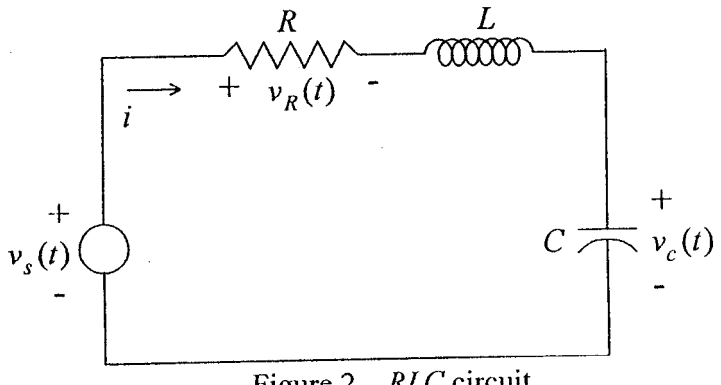

Figure 2　*RLC* circuit

【注意背面尚有試題】

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3. (25%) A 1000kg boxcar with a velocity 1 *m/s* approaches an arresting system composed of a linear spring and a viscous damper as shown in Figure 3.
   a. Derive the equation of motion describing what happens after the car contacts the arresting system.
   b. Find the time and distance when the car first time comes to rest. Assume that k=25*N/m* and b=350*N sec/m*.

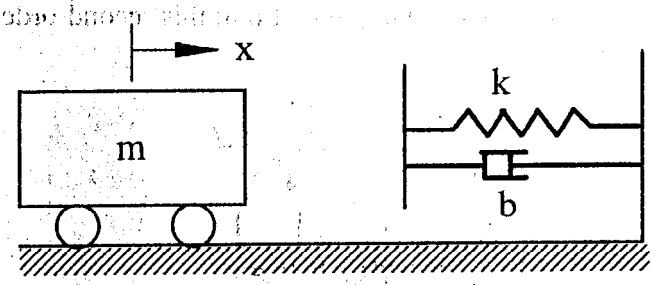

Figure 3　Boxcar

4. (25%) For the circuit shown in Figure 4, assume that the switch S_1 is opened for a long time and closed at t=0*sec*, then, the circuit can be viewed as a first-order system.
   a. Determine the capacitor voltage, $v_c(t)$ at $t=0^+$ *sec*.
   b. Derive an expression for the capacitor voltage $v_c(t)$ when $t>0$*sec*.
   c. What is the time constant, τ, of the circuit for $t>0$*sec*?

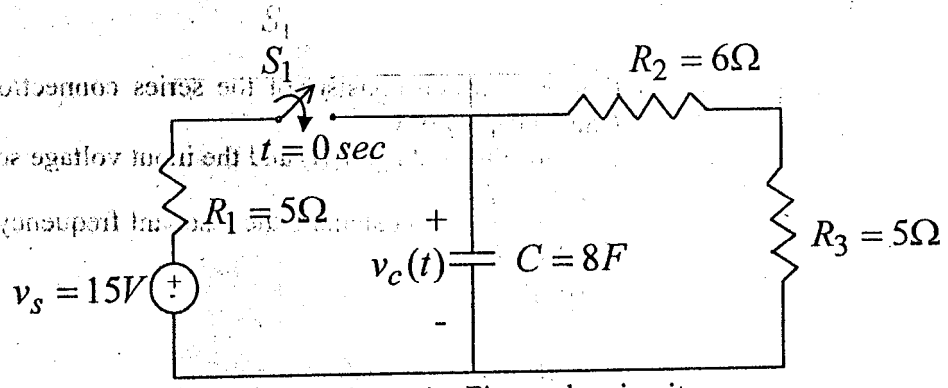

Figure 4　First-order circuit