淡江大學九十二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「○」否則打「×」
簡易型計算機
○

本試題雙面印製

(各小題所佔分數比例在括號內，總分為 100 分)

1. (25%) A wheel is moved by the mechanical system shown in the Figure 1. The mass of the wheel is m_w, and the mass of the attachment is m_c. For the case of a uniform disk, the moment of inertia for the wheel is given by $J=0.5m_wr^2$.
   a. Determine the modeling equations for the translational and rotational systems.
   b. Derive the transfer function for the output motion $z(t)$ as a function of the input motion $u(t)$, and find the static gain of the system at steady state.
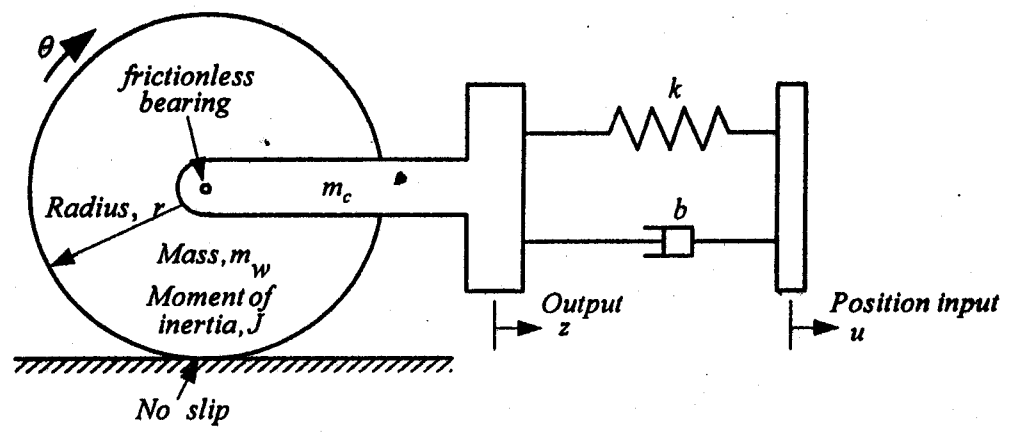

Figure 1　Wheel with position input system

2. (25%) Consider the *RLC* circuit of Figure 2, which consists of the series connection of a voltage source, $v_s(t)$, a resistor $R=1\Omega$, an inductor $L=0.1mH$, and a capacitor $C=10\mu F$.
   a. Find the transfer function between the capacitor voltage $v_c(t)$ and the input voltage source $v_s(t)$.
   b. Determine the damping ratio and natural frequency for the *RLC* circuit.
   c. Express the system equation in state variable form, use $v_c(t)$ and $i_L(t)$ as the state variables.
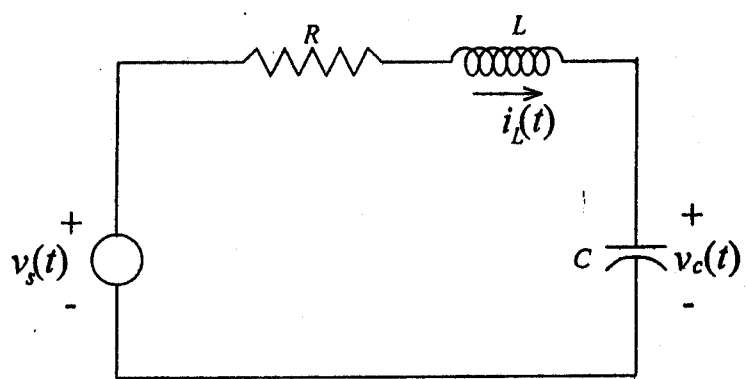

Figure 2　RLC circuit

【注意背面尚有試題】

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3. (25%) It is desired to design a drive system for electric vehicles. Each vehicle is motivated by two rear driving wheels. The drive system consists of a DC motor mounted on each of the driving wheel without any transmission (i.e. the motor is driving the wheel directly). The total weight of the vehicle and the driver is about 400kg. The radius of the rear wheel is 0.25 meter. If the wheels do no slip on the ground, and wind drag is negligible, answer the following questions.
   a. If the maximum velocity and acceleration of the vehicle are 50km/hr and 0.12m/sec², then, what is the maximum power supplied by each of the motors?
   b. If the torque constant of the motor is 0.5Nm/A, what is the motor current in case a? Also find the minimum battery voltage required for the vehicle to operate at 50km/hr.

4. (25%) For the circuit shown in Figure 3, assume that the switch S_1 is opened for a long time and closed at $t=0sec$, 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 $t>0sec$.
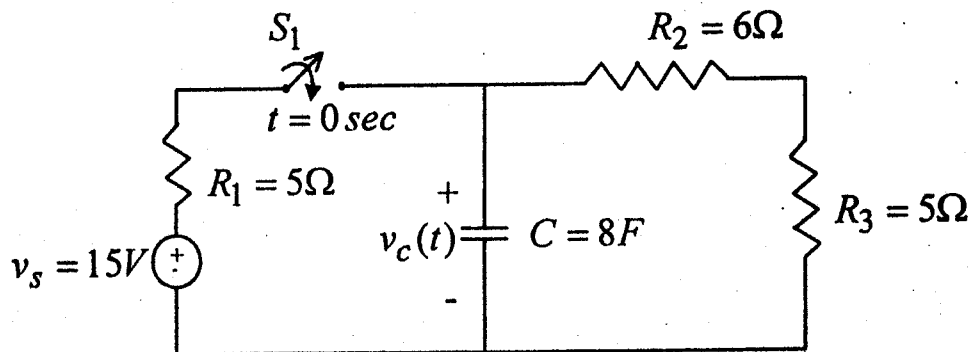   c. What is the time constant, τ, of the circuit for $t>0sec$?

Figure 3　First-order circuit