淡江大學九十一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

28-1

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計算機	字典
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1. *(20%)* Consider the two-mass dynamical system shown in Fig. 1, where *m1* and *m2* are connected with a spring, the spring constant is *k*. An external force *f(t)* is acting on *m1* in the horizontal direction. If the frictional force between the masses and the ground are negligible, and let $x = x1 - x2$, and $v = dx/dt$.
   a) Find the transfer function between *x(t)* and *f(t)* ?
   b) What is the resonant frequency of the system ?
   c) Express the system equation in state variable form, use *x* and *v* as the state variables ?

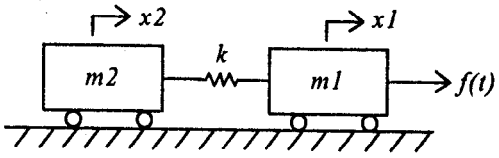

Fig. 1

2. *(20%)* The circuit shown in Fig. 2 has reached steady state before $t = 0$ sec. If the switch is closed at $t = 0$, find *i(t)* for $t > 0$?

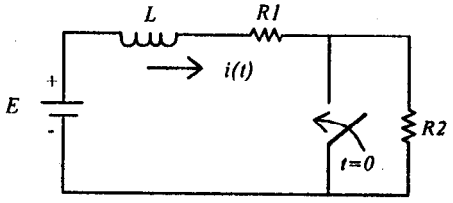

Fig. 2

3. *(20%)* An engineer is designing a drive system for electric motorcycles. The drive system consists of a DC motor mounted on the rear wheel of the motorcycle without any transmission (i.e. the motor is driving the rear wheel directly). The maximum torque the motor can output is 10 Nm. The total weight of the motorcycle and the cyclist is about 150 Kg. The radius of the rear wheel is 0.2 meter. If the wheels do no slip on the ground, and wind drag is negligible, answer the following questions.
   a) What is the shortest time the motorcycle needs to accelerate from 0 to 15 m/s ?
   b) If the torque constant of the motor is 0.5 Nm/A, then, what is the motor current in case a) ?
   c) What is the minimum battery voltage required for the motorcycle to operate at 15 m/s ?

◀注意背面尚有試題▶

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25-2

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4. *(20%)* The dynamic equation of a system is

$$\frac{dx}{dt} + x = 0, \quad \text{initial condition: } x(0) = 2.$$

Use **Euler's method** to simulate the above system from $t = 0$ to $t = 2$ sec, time step = 0.5 sec. What is $x(t)$ when $t = 2$ sec?

5. *(20%)* The electromagnetic actuator shown in Fig. 3 is to be used as a **punch** in a printer. When the winding is energized an electromagnetic force will be generated that pulls the plunger toward left to punch the paper. As soon as the winding is de-energized, the plunger will be pulled back to its original position by the spring. Neglecting the frictional force between the plunger and the iron core, the dynamical equations of the actuator can be expressed as

Electromagnetic force: $$f = -A \cdot \frac{i^2}{x^2}$$

Mechanical equations: $$m\frac{dv}{dt} = f - K(x - xi)$$

$$\frac{dx}{dt} = v$$

where: K: spring constant
x: effective air gap (plunger position)
xi: air gap when the spring force equals zero
v: plunger velocity
i: winding current
A: a constant related to winding inductance
m: mass of the moving core

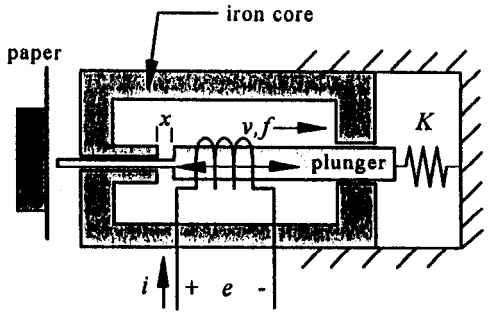

Fig. 3

It is desired to analyze the dynamical behavior of the system near $x = x0$ ($0 < x0 < xi$) and $v = i = 0$. Find the linearized system equations at this operating condition ?