國立臺灣科技大學101學年度碩士班招生試題

系所組別： 材料科學與工程系碩士班乙組

科　　目： 控制系統

（總分為100分）

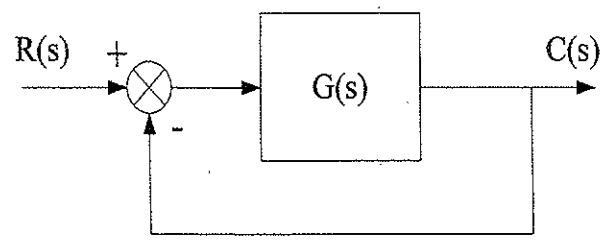
**總分 100 分，共 6 大題。**

1. For a unity feedback hydraulic position servo with loop gain function

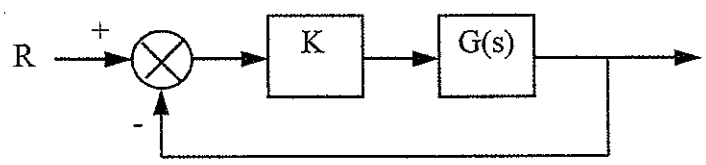
$$G(s) = \frac{K}{s(s^2 + 2s + 2)}$$

(a) Sketch the loci of the closed-loop system poles for varying K and find K for a damping ratio 0.5 for the complex poles. (8%)

(b) Calculate the unit step response and the unit ramp steady-state following error for the design of part (a). (7%)




2. For the system shown below, with $G(s) = \frac{A}{(Ts+1)}$ the parameters A and T are nominally 1, but each may vary by a factor of 2 in either direction with operating conditions. Find K so that despite these variations the steady-state errors for step inputs will not exceed 10% and the system time constant will stay below 0.2 sec. (15%)






3. A dc motor whose transfer function is of the form

$$\frac{\theta_o(s)}{E_a(s)} = \frac{K}{s(s+a)}$$

is available. The transfer function of the motor is found experimentally as follows:

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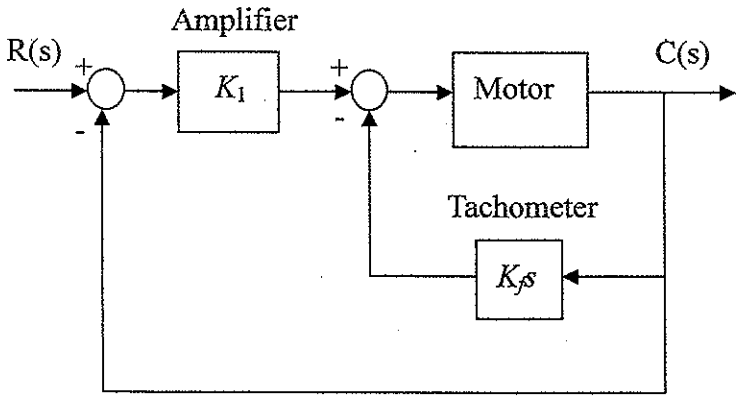
The motor and geared load are driven open-loop by applying a large, short, rectangular pulse to the armature. An oscillogram of the response shows that the motor reached 63% of its final output value at 1 second after the application of the pulse. Further, with a constant 1 volt dc applied to the armature, the constant output speed was 25 rad/s.

(a) Determine the transfer function of the motor. If this motor were the forward transfer function of a unity feedback system, calculate the percent overshoot and settling time that could be expected. (Use a 2% settling time) (10%)

(b) You want to improve the closed-loop response. Since the motor constants cannot be changed and you cannot use a different motor, an amplifier and tachometer are inserted into the loop as shown in the figure. Find the values of $K_1$ and $K_f$ to yield a percent overshoot of 25% and a settling time of 0.2 second. (10%)






4. A second-order, unity feedback system is to follow a ramp input with the following specifications: the steady-state output position shall differ from the input position by 0.01 of the input velocity; the natural frequency of the closed-loop system shall be 10 rad/s. Find the following:

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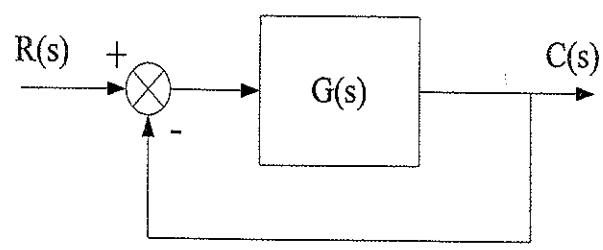
(a) The system type (4%)

(b) The exact expression for the forward-path transfer function G(s) (7%)

(c) The closed-loop system's damping ratio (4%)




5. Use the Routh stability criterion to determine the number of roots in the left-half plane, the right-half plane, and on the imaginary axis for the given characteristic equation: $s^4+2s^3+8s^2+4s+3=0$ (15%)

6. 下圖顯示出一個機械振盪系統，當 9 Nt 的力施加於系統時，質量如下圖振盪，從響應中決定系統的 $M$、$B$ 和 $K$ 值。 (20%)