國立嘉義大學 100 學年度

生物機電工程學系碩士班（乙組）招生考試試題

科目：自動控制（※禁止使用計算機）

1. For a system with output *y* and input *r* described by the following equation,

$$\frac{d^5y}{dt^5}+2\frac{d^4y}{dt^4}+3\frac{d^3y}{dt^3}+5\frac{d^2y}{dt^2}+11\frac{dy}{dt}+12y=\frac{d^2r}{dt^2}+4\frac{dr}{dt}+7r$$

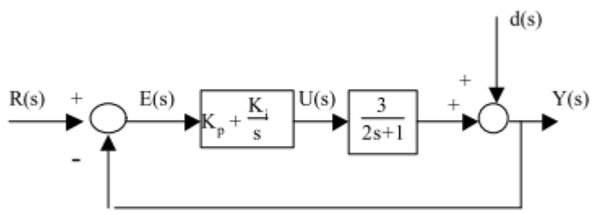
   (a) Find the transfer function of the system. (5%)

   (b) Determine the stability of the system using the Routh-Hurwitz criterion. (10%)

   (c) Write down an equivalent state space representation. (5%)

   (d) Sketch the state variable diagram. (5%)

2. Consider the use of proportional-integral control for reference tracking performance and disturbance rejection. Let the reference be given as $r(t) = r$ and the disturbance as $d(t) = d$ in the following system：



(a) write down the system response, (10%)

(b) determine the tracking performance, and (7%)

(c) determine the disturbance rejection performance. (8%)

3. The convolution operation relates the general input to a system, $u(t)$, via the impulse response of the system, $g(t)$, to the output, $x(t)$. Show that for a linear, time-invariant system, the system response is the ‘convolution integral’ of the function $g(t)$ and the input $u(t)$: (12%)

$$\begin{aligned} x(t) &= g(t)*u(t) \\ &= \int_0^t g(t-\tau)u(\tau)d\tau \end{aligned}$$

The response of a first order system to a unit impulse input is given by

$$g(t)=e^{-at}$$

Using the convolution equation directly to determine the response to a ramp input $u(t)=bt$. (13%)

4. The force and position relations for the translational mechanical mass, spring, and damper elements are given in the following figure.

   (a) Write the differential equation in term of the indicated mass position. (8%)

   (b) Use the Laplace transform to obtain the transfer function. (8%)

   (c) If *M*=2, *B*=6, *K*=5, and *f* is a unit step function, find the system response. (9%)