

系所組別： 電機工程學系乙組

考試科目： 控制系統

考試日期：0226，節次：2

1. (25%) For the unity feedback control system with an open-loop transfer function

$$G(s) = \frac{K(s + \alpha)}{s(s + \beta)},$$

find the values of  $K$ ,  $\alpha$ , and  $\beta$  in order to meet the following specifications: The steady-state position error for a unit ramp input equals 0.1;  $\zeta = 0.7$ ;

$$\omega_n = 10 \text{ rad/sec}.$$

2. (25%) Consider the plant  $G(s) = \frac{s+2}{(s+5)(s+9)}$  whose phase variables are not available.

Design an observer for the phase variables with a transient response described by

$$\zeta = 0.7 \text{ and } \omega_n = 10 \text{ rad/sec}.$$

3. (25%) A vertical launch rocket has mass  $m$  and thrust  $T$ . The rocket is subject to

gravitational attraction with acceleration  $g = g_0 \left( \frac{R}{R+h} \right)^2$  where  $g_0$  is a constant,  $R$

is the radius of the earth, and  $h$  is the altitude.

- i. (10%) Obtain the differential equation that describes the relationship between the input thrust  $T$  and the output altitude  $h$ .
  - ii. (10%) The equation is nonlinear, find the linear approximation at  $h=0$  and determine the transfer function from the input to the output.
  - iii. (5%) Evaluate the poles of the system.
4. (25%) Consider the system in the figure in which a controller is to be designed to stabilize the system,
- i. (10%) Show that the system cannot be stabilized by a PI controller.
  - ii. (15%) Find a controller that stabilizes the system.

