113VE03

國立臺北科技大學 113 學年度碩士班招生考試

系所組別：1302 車輛工程系碩士班

第二節　自動控制　試題（選考）

注意事項：

1. 本試題共 5 題，每題 20 分，共 100 分。
2. 不必抄題，作答時請將試題題號及答案依照順序寫在答案卷上。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. Consider the following differential equation

$$y''(t)+3y'(t)+2y(t)=5u_s(t)$$
$$y(0)=-1,\ y'(0)=2.$$

where $u_s(t)$ is the unit-step function.

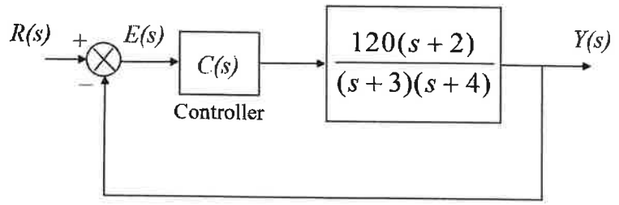
(a) Calculate the steady-state output value by using the Final-value Theorem. (10%)
(b) Please solve the total response of $y(t)$ and verify the result with (a) when t→∞. (10%)

2. In the following, a control system is represented in a state-space form, where **x** is the state variable, u is the system input, and y is the system output:

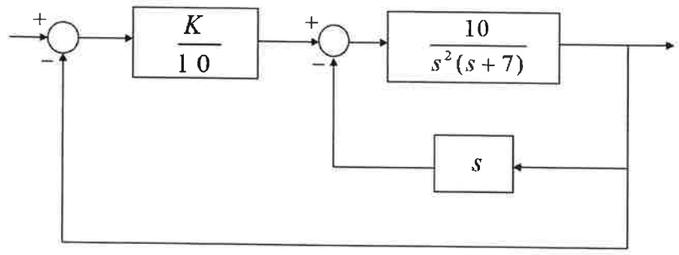
$$\dot{\mathbf{x}}=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ -1 & -2 & -3\end{bmatrix}\mathbf{x}+\begin{bmatrix}10\\ 0\\ 0\end{bmatrix}u$$
$$y=\begin{bmatrix}1 & 0 & 0\end{bmatrix}\mathbf{x}$$

(a) By taking the Laplace Transform, please solve the system transfer function from the above state space representation. (10%)
(b) Please identify the system stability. If stable, please find the DC gain of this system. If it is not stable, please give your reason. (10%)

3. Given the following feedback system with a controller $C(s)$:
(a) If setting the controller as $C(s) = 1$, please determine the steady-state error when the input $R(s)$ is a unit-step function. (10%)
(b) With the same input in (a), please design a proper controller $C(s)$ to reduce the steady-state error for this closed-loop system. Detail your results. (10%)



4. For the following control system, please solve the problems.



(a) Please obtain the root locus for the range of $0 \le K < \infty$. The details for your procedure are required. (15%)
(b) Please find the maximum value of K for the closed-loop system stability. (5%)

5. Consider the following system transfer function:

$$G(s)=\frac{1}{(s+2)(s^2+2s+5)}$$

Suppose a unity feedback with a constant gain controller K is designed into a negative feedback loop, where the forward gain is $KG(s)$ and the loop gain is also $KG(s)$.

(a) Sketch the Bode plots of $G(s)$ by hand. (10%)
(b) Using the Nyquist plot, determine the range of K for stabilizing the closed-loop system. (10%)