國立臺北科技大學

九十二學年度車輛工程系碩士班入學考試

自動控制試題

填准考證號碼

注意事項：

1. 本試題共[redacted]題，配分共 100 分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在答案卷之答案欄內，否則不予計分。

1. True and False problems (Answer **True** or **False** for each problem. **You need to provide reasons to support your answer. Otherwise, the answer will be graded as incorrect answer.** **5** points for each **correct** answer and **-2.5** points for each **incorrect** answer): (20%)

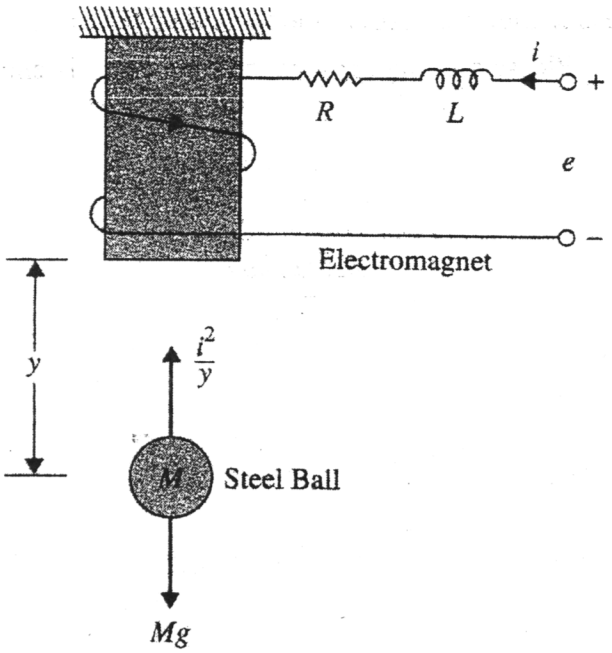
(1) The frequency response of $G(s)=\dfrac{s-1}{(s+3)(s+10)(s+20)}$ has a final phase (when $\omega\to\infty$) of -180 degree.

(2) For a plant with 3 poles and 1 zero in the Left Half Plane, root locus for the unity-feedback closed-loop system under P control will have three branches, and PI control will have four branches.

(3) The step response of a type-one second order plant (one pole at 0, the other pole is stable) goes to a non-zero steady-state value.

(4) $\dfrac{d}{dt}\begin{bmatrix}x_1\\x_2\end{bmatrix}=\begin{bmatrix}0 & 1\\-1 & -2\end{bmatrix}\begin{bmatrix}x_1\\x_2\end{bmatrix}+\begin{bmatrix}0\\1\end{bmatrix}u$ is not controllable since u can only affect x_2.

2. The following figure shows the diagram of a magnetic-ball-suspension system. Let us define the state variables as $x_1(t)=y(t)$, $x_2(t)=\dot{y}(t)$, and $x_3(t)=i(t)$. The input is defined as $u(t)=e(t)$. Please derive a set of state equations to describe the system. (5%) Please linearize the state equations around the point where $y(t)=y_0$. (15%)

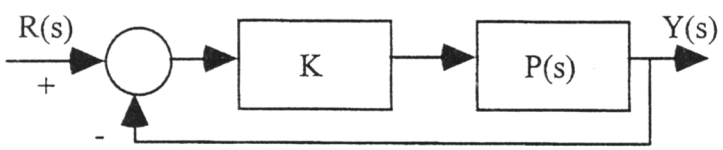


3. For the plant $P(s)=\dfrac{s+10}{(s+1)(s-1)}$,

(1) Obtain a rough sketch of the Nyquist plot with K=1 (5%)

(2) What is the range of K for a stable closed-loop system? (5%)

(3) For K outside of the stable range, when will there be two unstable poles? (5%) When will there be only one unstable pole? (5%)

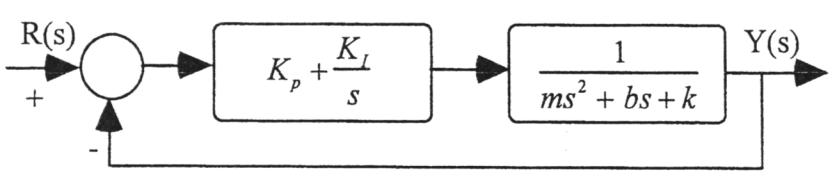


4. For the following control system, it is desirable to study the effect of spring stiffness (k) variation on closed-loop pole locations. Plot the root locus for this purpose (assuming that k can vary from 0 to infinity) when the other parameters are fixed at $m=1$, $b=3$, $K_P=3$ and $K_I=1$. You must show

(1) $a(s)$ and $b(s)$ based on which your root locus was obtained (5%)

(2) Angle of departure from the poles (5%) and Asymptotes (5%)

(3) Final sketch (5%)



注意：背面尚有試題

5. From the following Bode plot, reconstruct the transfer function (10%). What is the phase margin? (5%). Please calculate how much time delay is enough to de-stabilize the system (5%)