國立彰化師範大學九十六學年度碩士班招生考試試題

系所：工業教育與技術學系　　組別：乙組　　科目：自動控制

★★請在答案紙上作答★★

1. The circuit diagram of a separately excited dc motor is shown in Fig. 1. Assume that the air-gap flux is $\phi(t) = k_f I_f = constant$ and the torque developed by the motor is $T_m(t) = k_m \phi(t) i_a(t) = k_t i_a(t)$, where $k_t = k_m \phi(\mathrm{t}) = k_m k_f I_f = constant$. The motor variables and parameters are defined as follows:

$Va(t)$：applied voltage　　$ia(t)$：armature current

$Eb(t)$：back emf　　$\omega_m(t)$：rotor angular velocity

$Tm(t)$：motor torque　　$T_L(t)$：motor torque

$\phi(t)$：magnetic flux in the air gap

La：armature inductance　　Ra：armature resistance

Jm：rotor inertia　　Bm：viscous-friction coefficient

k_t：torque constant　　k_b：back-emf constant

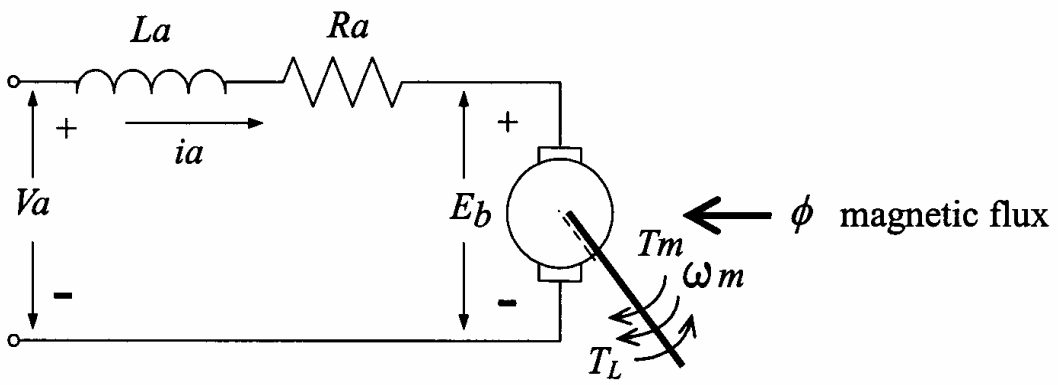


Fig. 1

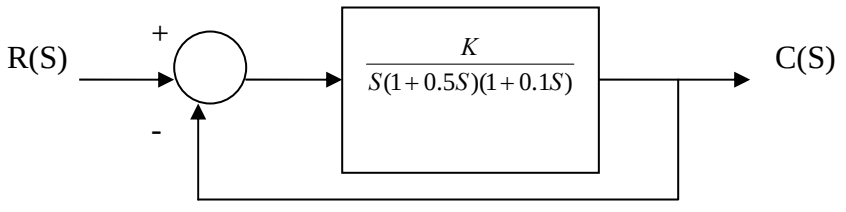
(1) Draw the block diagram of this system.　(10%)

(2) Find the transfer function $\frac{\omega_m(s)}{V_a(s)}$.　(10%)

2. A negative unity feedback control system $G(s) = \frac{12(S+4)}{S(S+2)(S+3)}$. If input $r(t) = (16 + 2t + t^2)$, please find the steady-state error e_{ss}.　(15%)

3. An open-loop transfer function $GH(S) = \frac{100(S+10)}{S(S+5)(S+20)}$. Please sketch bode plot of the system.　(15%)

4. A system control block diagram shown as below:



Please find the Root Locus of this system.　(20%)

5. Consider the following state equation and output equation.

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix}=\begin{bmatrix}-3 & 2\\ 1 & -2\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}+\begin{bmatrix}1\\ 0\end{bmatrix}u$$

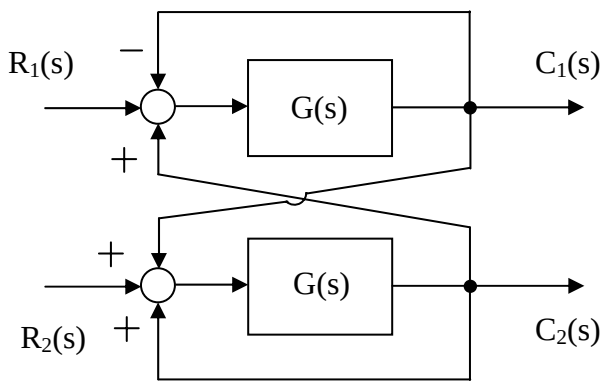
$$y=\begin{bmatrix}1 & -1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}.$$

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

(2) Check the controllability and observability. (5%)

(3) Design a state feedback controller $u(t)=-Kx(t)+r(t)$ such that the closed-loop system poles are $S_{p1}=-4$ and $S_{p2}=-8$. (5%)

6. The block diagram of the system $\begin{bmatrix}C_1(s)\\ C_2(s)\end{bmatrix}=G_M(s)\begin{bmatrix}R_1(s)\\ R_2(s)\end{bmatrix}$ is shown as below:



Please find the transfer function matrix $G_M(s)$. (15%)