※ 考生請注意：本試題 □可 ☑不可 使用計算機

1　The system is described as
$$\dot{x}(t) = Ax(t) + Bu(t)$$
$$y(t) = Cx(t)$$
Where A, B and C are constant matrices

Answer the following questions

(a) (5 points) How to check the BIBO stability of the system?

(b) (5 points) How to check the controllability and observability of the system?

(c) (5 points) How to derive the transfer function of the system?

(d) (10 points) $AX_1 = \lambda_1 X_1$, $AX_2 = \lambda_2 X_2$ where $X_1 \neq 0$ and $X_2 \neq 0$

　　If $\lambda_1 \neq \lambda_2$, please show that X_1 and X_2 are linearly independent.

(e) (10 points) Can you find a nonsingular matrix Q and let $Q^{-1}AQ$ be a diagonal matrix for any matrix A?
If your answer is yes, please show how to find the nonsingular matrix Q. If your answer is no, please explain why?

(f) (5 points) What is Jordan form matrix?

2. (a) (10 points) Show the advantages and disadvantages on analog controller and digital controller.
(b) (10 points) How to design an analog and a digital controller for a DC servo motor, respectively. (Just show the design concepts)

3. (20 points) Write down the definition of Gain margin and phase margin and explain how to use gain margin and phase margin to check the system's stability.

4. (20 points) For a controllable system, we can use state feedback to stabilize an unstable system. Please show that the state feedback will not change the controllability and may (or may not) change the observability.