編號： 178 **國立成功大學 105 學年度碩士班招生考試試題**

系所組別：電機工程學系

考試科目：控制系統 考試日期：0227，節次：2

※ 考生請注意：本試題不可使用計算機。 請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. Solve the following differential equation by using the Laplace transform method: **(25%)**

$$\frac{d^2x(t)}{dt^2}+8\frac{dx(t)}{dt}+25x(t)=\sin 3t;\ x(0)=1;\ \frac{dx}{dt}(0)=2$$

2. Find the state-space representation in parallel form for the following system: **(25%)**

$$G(s)=\frac{-250(s^2+2s+80)}{(s-1.6)(s+4.5)(s+12)}$$

3. (a) Use Routh (or Routh-Hurwitz) stability criterion to determine how many roots of the equation, $s^5+8s^4+9s^3-18s^2+20s=200$, are located in the left half plane, on the $j\omega$ axis, and in the right half plane. **(12%)**

(b) If there are some roots on the $j\omega$ axis, please determine them. **(8%)**

4. Consider the LTI system with state equation $\dot{\mathbf{x}}_{n\times 1}(t)=\mathbf{A}_{n\times n}\mathbf{x}(t)+\mathbf{B}_{n\times p}\mathbf{u}_{p\times 1}$, initial $\mathbf{x}(0)=\mathbf{x}_0$, and output equation $\mathbf{y}(t)_{q\times 1}=\mathbf{C}_{q\times n}\mathbf{x}(t)+\mathbf{D}_{q\times p}\mathbf{u}(t)$. Please derive and find the impulse response matrix $\mathbf{G}_{q\times p}(t)$. **(12%)**

5. Definition: An initially relaxed system is said to be bounded-input bounded-output (BIBO) stable if every bounded input excites a bounded output.

Definition: A function $h(t)$ is said to be absolutely integrable in $(0,\infty)$ if $\int_0^\infty |h(t)|dt \le m<\infty$ for some positive constant *m*.

Consider a single-input single-output (SISO) linear time-invariant system,

$$y(t)=\int_0^t g(t-\tau)u(\tau)d\tau=\int_0^t g(\tau)u(t-\tau)d\tau \qquad \text{(Equation } \alpha\text{)}$$

where $y(t)$ is the output, $g(t)$ is the impulse response, and $u(t)$ is the bounded input with $|u(t)|\le u_m<\infty$ for all $t\ge 0$. Please show that a SISO system described by Equation (α) is BIBO stable if and only if $g(t)$ is absolutely integrable in $(0,\infty)$. **(18%)**