國 立 臺 北 科 技 大 學

九十六學年第一學期電機系博士班資格考試

現代控制理論試題(公告用)

填 學 生 證 號 碼

注意事項：

1. 本試題共【6】題，配分共 120 分，70 分及格。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在試卷答案欄內，否則不予計分。
4. 考試時間：二小時。

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1. Given a matrix $\mathbf{A} = \begin{bmatrix} 0 & 1 \\ -9 & -6 \end{bmatrix}$, find $\cos(\mathbf{A}t)$. (20%)

2. Given a matrix $\mathbf{A} = \begin{bmatrix} 1 & 3 & -4 & 6 & 1 & -2 \\ 2 & 4 & 0 & -3 & 0 & -3 \\ 0 & 1 & 0 & 2 & 2 & 3 \\ 5 & 2 & 5 & -4 & 5 & 5 \end{bmatrix}$, (a) find the orthonormal bases of the range space

   of $\mathbf{A}$; (b) find the orthonormal bases of the null space of $\mathbf{A}$. (20%)

3. Given that two matrices $\mathbf{A}$ and $\mathbf{B}$ are similar, show that $\mathbf{A}$ and $\mathbf{B}$ have the same eigenvalues. (20%)

4. Show that the controllability of a system ($\mathbf{A,B,C,D}$) is invariant under any equivalence transformation. (20%)

5. Given a transfer function $M(s) = \dfrac{s+2}{(s+1)(s+3)(s+2)}$, please transform the M(s) into a

   dynamic equation which is (a) a controllable canonical form (b) a observer canonical form. Please verify your controller canonical form in (a) and observer canonical form in (b) is controllable or observable, respectively. (20%)

6. Find a state feedback gain for the system ($\mathbf{A, B, C}$) where (20%)

   $A = \begin{bmatrix} 1 & 1 & -2 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix}$, $B = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}$, C=[1 2 3]. so that the resulting system has eigenvalues -3, $-2 \pm j1$.