國立臺北科技大學

九十六學年第二學期電機系博士班資格考試

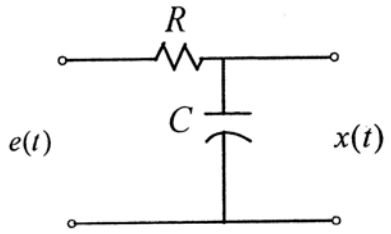
數位控制理論與應用試題

填學生證號碼　　第一頁　共一頁

注意事項：

1. 本試題共【5】題，配分共 100 分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在試卷答案欄內，否則不予計分。
4. 考試時間:二小時。

1. (20%) Consider the RC circuit shown in following figure. Derive the difference equation describing the dynamics of the circuit when the input voltage applied is piecewise constant, or $e(t) = e(kT), \quad kT \le t < (k+1)T$.



2. Consider the system with pulse transfer function: $\dfrac{Y(z)}{U(z)} = \dfrac{z^2+7z+9}{z^2+5z+6}$.

   (1) (10%) please find the corresponding state-space diagonal canonical form.

   (2) (10%) derive the state feedback law $u(k) = -Kx(k)$ for dead-beat response.

3. (20%) Consider the characteristic equation of a discrete-time control system given as $z^3 - 1.368z^2 + 0.368(K+1)z + 0.264K = 0$.

   Please find the range of K for system stability.

4. (20%) For the backward discrete-equivalent rule ($s \leftarrow {}^{(z-1)}/_{zT}$), show that

$$\begin{cases} \dot{x}(t) = Ax(t) + Be(t) \\ u(t) = Cx(t) + De(t) \end{cases}$$

can be digitized equivalently in the form of

$$\begin{cases} w(k+1) = \Phi w(k) + \Gamma e(k) \\ u(k) = Hw(k) + Je(k) \end{cases}$$

where $\Phi = (I - AT)^{-1}$, $\Gamma = (I - AT)^{-1} BT$,

$$H = C(I - AT)^{-1}, \quad J = D + C(I - AT)^{-1} BT .$$

(Hint: let $x(k) = w(k+1)$.)

5. (20%) Find the pulse transfer function from $R(z)$ to $C(z)$ for the following block diagram.