2019 年 – 2020 学年度第 二 学期
华中科技大学本科生课程考试试卷(A 卷)

课程名称：**自动控制原理（二）** 课程类别 □公共课 ■专业课 考试形式 ■开卷 □闭卷

所在院系：_____ 专业及班级：_____ 考试日期：_____

学　号：_____ 姓　名：_____ 任课教师：_____

题号	一	二	三	四	五	六	七	总分
分数								

Table of Z-transform

E(s)	1	$\frac{1}{s}$	$\frac{1}{s^2}$	$\frac{1}{s+a}$	$\frac{1}{(s+a)^2}$
e(t)	$\delta(t)$	1(t)	t	e^{-at}	te^{-at}
E(z)	1	$\frac{z}{z-1}$	$\frac{Tz}{(z-1)^2}$	$\frac{z}{z-e^{-aT}}$	$\frac{Tze^{-aT}}{(z-e^{-aT})^2}$

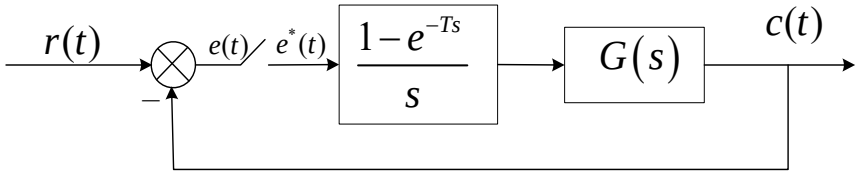
得分	评卷人

1.（20 分）The discrete-time system is shown in the following figure， $G(s)=\dfrac{k}{s(0.1s+1)}$**, T=0.1.**

(1) Obtain the closed-loop impulsive transfer function.

(2) Determine the stable range of *k*.

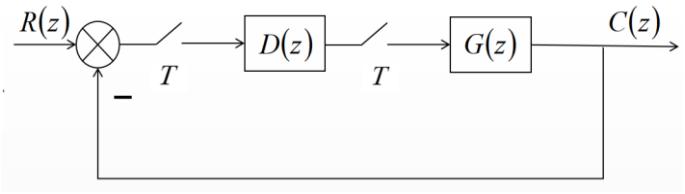
(3) If *k*=1, Obtain *e*(∞) for r(t)=1(t)+t. (Note: $e^{-1}=0.368$**)**



得分	评卷人

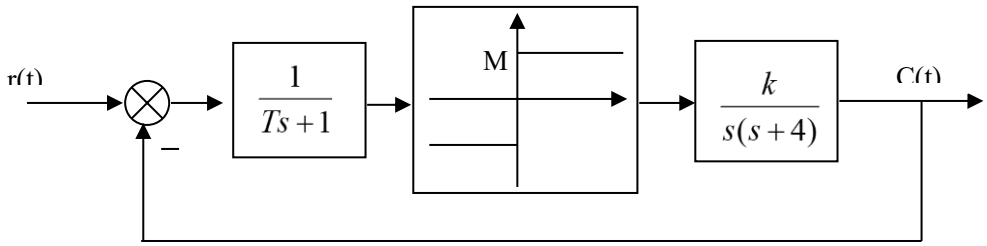
2.（10 分）The structure of a nonlinear system is shown in the following figure, where $G(z)=\dfrac{0.5z^{-1}\left(1+0.15z^{-1}\right)\left(1+1.03z^{-1}\right)}{\left(1-z^{-1}\right)\left(1-0.25z^{-1}\right)\left(1-0.0133z^{-1}\right)}$.

Design a deadbeat controller $D(z)$ **for input** $r(t)=1(t)$.



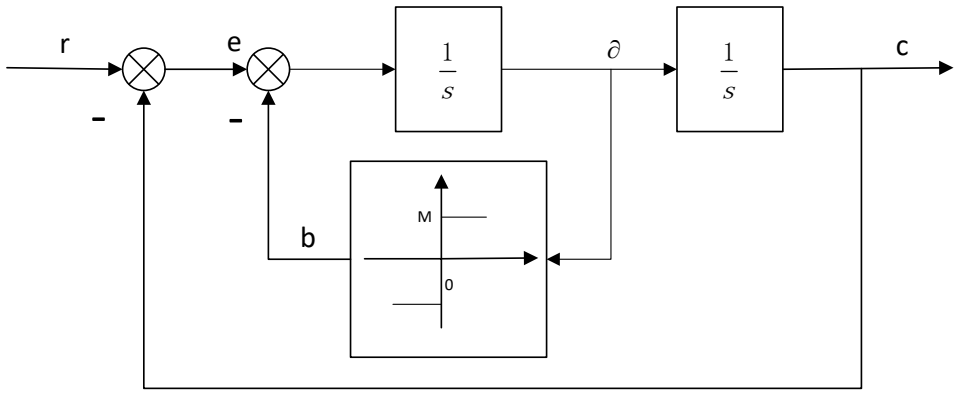
得分	评卷人

3. （10分）The nonlinear system is shown in following figure , with $r(t)=0$，$k>0$，$T>0$ **and M=2. Please design parameters *k* and T, such that it occurs the self-oscillation(自激振荡) with amplitude A=2 and** $\omega=2$. **(**$N(\mathrm{A})=\dfrac{4M}{\pi A}$**)**



得分	评卷人

4.（15分）Consider the nonlinear system as shown in Figure $M=0.5$ **. The initial（初始）conditions are** $c(0)=0$、$\dot{c}(0)=0$ **and** $r(t)=2\times 1(t)$**, Draw the phase trajectory（相轨迹） in the plane** $c-\dot{c}$**.**



得分	评卷人

5.（15 分）If the state transition matrix（状态转移矩阵） Φ(t) of a state-space system ss(A,B,C) is:

$$\Phi(t)=\begin{bmatrix} 2e^{-t}-4e^{-2t} & 4e^{-t}-e^{-2t} \\ -2e^{-t}+e^{-2t} & -3e^{-t}+2e^{-2t} \end{bmatrix}$$

The input vector（输入向量） B=[0,1]^{T}. System's initial states（初始状态） are $x_1(0)=1$, $x_2(0)=0$**. The input** $u(t)=1(t)$**.**

(1) Obtain the state equation （状态方程） of the system.

(2) Solve this state equation （求解状态方程）.

得分	评卷人

6.（10 分）Consider the following state-space presentation

$$\begin{cases} \dot{\boldsymbol{x}} = \begin{bmatrix} 1 & 1 \\ -6 & -4 \end{bmatrix} \boldsymbol{x} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u \\ y = \begin{bmatrix} a & 1 \end{bmatrix} \boldsymbol{x} \end{cases}$$

(1) Find the state transition matrix（状态转移矩阵）.

(2) Determine the range of a， which ensures the system observability.

得分	评卷人

7.（20 分）Assume the transfer function（传递函数） of system is:

$$G(s) = \frac{(s-1)(s+2)}{(s+1)(s-2)(s+3)}$$

(1) Establish its corresponding（对应的） state-space representation of controllable canonical form（能控标准型）.

(2) Design a state feedback （状态反馈） structure to make the transfer function of the closed loop system satisfying（满足）：$\Phi(s) = \dfrac{s-1}{(s+2)(s+3)}$.

(3) Draw the state va riable diagram （状态变量图） of the closed loop system with state feedback.

(P.S.: The state feedback structure won't change the zeros of the original system——状态反馈不改变原系统的零点)