

National Taiwan University

Digital Control System

Homework 1

2020-4-21

1. Find the z-transform using partial fraction expansion if $T=0.1$ sec

$$(a) \quad G(s) = \frac{(s+1)(s+2)}{s(s+3)(s+4)}$$

$$(b) \quad G(s) = \frac{27}{(s+2)(s^2+4s+13)}$$

2. Repeat Problem 1 by using MATLAB Symbolic Math Toolbox

3. Compute the inverse transform $f(k)$ for the following transforms:

$$F(z) = \frac{(z+1)(z+0.3)(z+0.4)}{z(z-0.2)(z-0.5)(z-0.7)}$$

4. Repeat Problem 3 by using MATLAB Symbolic Math Toolbox

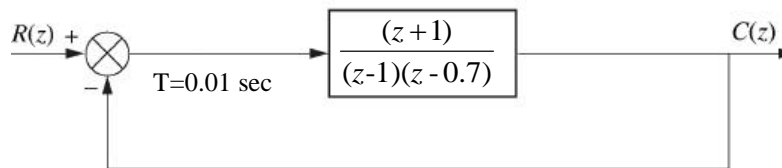
5. The system function is

$$H(z) = \frac{Y(z)}{U(z)} = \frac{(z+1)}{(z-1)(z-0.7)}$$

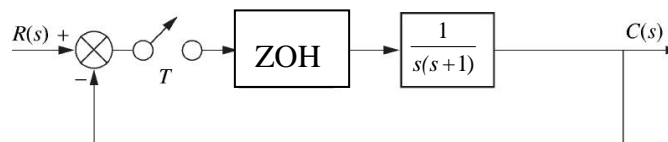
$$u(kT) = \begin{cases} \sin(10\pi kT), & k \geq 0 \\ 0 & k < 0 \end{cases},$$

$$y(0) = 0, \quad y(-1) = 0, \quad T = 0.01 \text{ sec}$$

- (a) Derive the difference equation of the system function $G(z)$
- (b) Solve and plot the output $y(k)$ of the difference equation via MATLAB for 1 sec.
- (c) Derive the closed-loop transfer function $T(z)$
- (d) Solve and plot the output $y(k)$ of the difference equation as input $r(t)=10u(t)$ via MATLAB for 1 sec.



6. Given the system as shown below. Find the range of sampling time that keeps the system stable.



7. Please use Jury method to prove if the following characteristic equation is stable

$$F(z) = z^5 + 2.6z^4 - 0.56z^3 - 2.05z^2 + 0.0775z + 0.35$$

8. A process is described by the difference equation

$$\begin{aligned} y(k) + 12y(k-1) + 7.2y(k-2) + 3.2y(k-3) \\ = 4u(k-1) - 4u(k-2) + 8.4u(k-3) \end{aligned}$$

- (a) Determine the state representation in controllable canonical form and observable canonical form.
- (b) Determine the characteristic equation.
- (c) Is the process stable? Please show it by Jury criteria.

Note: Please submit the HW1 in a PDF file via CEIBA.

Deadline : 12/05/2020