CSE421: Digital Control

# Assignment 4

## Stability

**Q1.** Check the stability of the discrete-time control systems having the following characteristic equations:

$$(a) \quad z^2 - z + 2 = 0$$

$$(b) \quad z^2 - 0.81 = 0$$

$$(c) \quad z^3 - 1.3z^2 + 0.08z + 0.24 = 0 \quad (stable)$$

$$(d) \quad z^3 + 1.2z^2 + 1.44z - 0.32 = 0$$

$$(e) \quad z^3 - 1.1z^2 - 0.1z - 0.2 = 0$$

$$(f) \quad z^4 - 1.2z^3 + 0.07z^2 + 0.3z - 0.8 = 0 \quad (unstable)$$

**Q2.** Consider the following closed-loop discrete-time unity feedback control system with sampling period T = 1 sec. Determine the range for K for stability by use of Jury's test and also determine the frequency of oscillations.

$$G(z) = \frac{K(0.368z + 0.264)}{(z - 0.368)(z - 1)}.$$

**Q3.** Consider the discrete-time control system described by the difference equation,

$$y(k) - 0.6y(k-1) - 0.81y(k-2) + 0.6y(k-3) - 0.12y(k-4) = x(k),$$

where, x(k) is the input of system and y(k) is the output of system. Determine the stability of the system.

**Q4.** A second-order discrete-time system has the following characteristic equation:

$$F(z) = z^2 + a_1 z + a_0 = 0.$$

Show the region in the given $a_0$–$a_1$ plane for which the given system is stable.