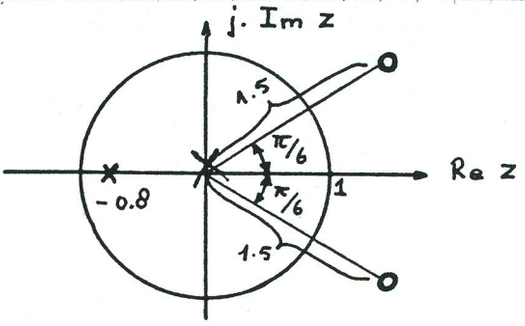
III – 1. a Determine the system function and impulse response of the system with the poles and zeroes defined by the figure below:



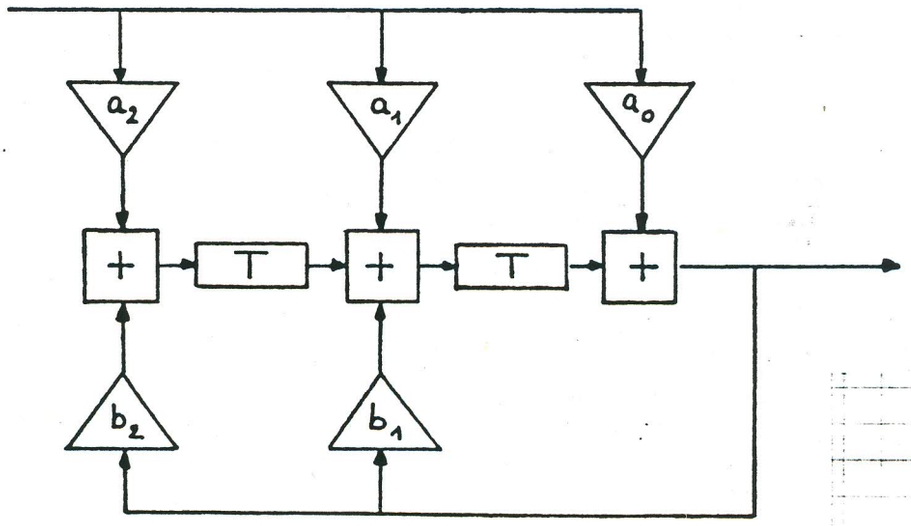
× – pole

○ – zero

b Is this a stable system?

c Sketch a possible implementation of the system and determine the corresponding difference equation(s).

III – 2. a Determine in three different ways the system function of the second-order system below.



b Determine for:

$a_0 = a_2 = 1$

$a_1 = 2$

$b_1 = 1.5$

$b_2 = -0.9$

the poles and zeroes of $\tilde{H}(z)$ and check the stability of the system.

c As b, however with

$b_1 = 1$, $b_2 = -2$.

III-3. When in the system of problem III-2 the coefficients a_1 and a_2 are put to zero, a purely recursive structure results.

a Determine the $\tilde{H}(z)$ for this case

b Determine the response to

$$x(n) = A \cos\left(n \frac{\pi}{3}\right)$$

when: $b_1 = 1$, $b_2 = -0.99$.

c Given $b_1 = 1.2$ and $b_2 = -0.52$ write the system function in the form:

$$\tilde{H}(z) = \frac{A}{z - p_1} + \frac{B}{z - p_2} + K .$$

and determine p_1, p_2, A, B and K.

d With the settings of part c determine the impulse response $h(n)$ for values of $n = 0, 1, \ldots, 8, 9$.