$$\underline{\text{מבחן - פס } 9}$$

$$r(t) \rightarrow \otimes \xrightarrow{\theta(t)} \diagup \xrightarrow{\theta^*(t)} \boxed{\begin{array}{c} ZOH \\ G_0(s) \end{array}} \rightarrow \boxed{\begin{array}{c} process \\ G_p(s) \end{array}} \xrightarrow{y(t)}$$

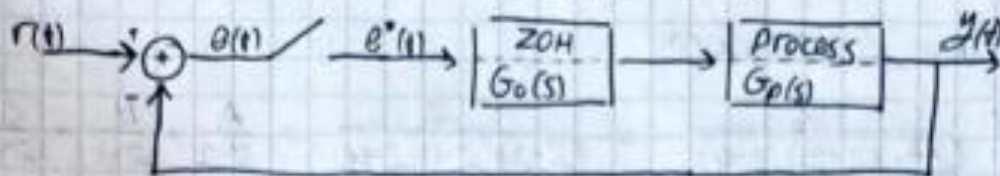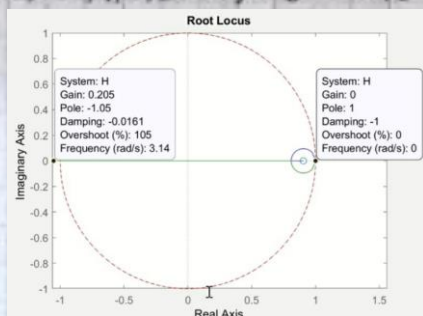## 1) Discrete Control 1

$$G_p = \frac{K(1+10S)}{S^2} \qquad , \quad \tau = 1 \Rightarrow G_0(s) = \frac{1-e^{-s}}{s}$$

$$\bar{G}(z) = \mathcal{Z}\{G_0 G_p\} = K(1-z^{-1})\mathcal{Z}\{\frac{1+10S}{S^3}\} = K(1-z^{-1})\mathcal{Z}\{\frac{1}{S^3}+\frac{10}{S^2}\} =$$

$$= K(1-z^{-1})(\frac{1}{2}\cdot\frac{z(z+1)}{2(z-1)^3}+\frac{10z}{(z-1)^2}) = K(\frac{z+1}{2(z-1)^2}+\frac{10}{z-1}) = K(\frac{21z-19}{2(z-1)^2})$$

$$1+\bar{G}(z) = 0 \qquad \text{נרשם מחדש לקבלת}$$

$$2(z-1)^2 + K(21z-19) = 2z^2 + (2K-4)z + (2-19K) = 0$$

השורש של לוקוס הגבר:

$$0 < K < 0.2 \quad \text{הוא עבור}$$

הקבצים משאירים יחידה

ואם נקבע K לערך גבולי אז נקבל את z=-1

$$K = -\frac{2(-1-1)^2}{21(-1)-19} = \frac{8}{40} = 0.2$$

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2) Discrete Control 2

$$G(z) = \frac{K(z+0.2)}{z(z-1)}$$

(1) שרטוט לוקוס: (2) מאת קטבים:

$$1+G(z) = 0$$

$$z^2+(K-1)z+0.2K = 0 \Rightarrow K = -\frac{z(z-1)}{z+0.2}$$

נבדק נק' יציבה גבולית:

$$K = -\frac{-1(-2)}{-1+0.2} = \frac{2}{0.8} = 2.5$$

$$0 < K < 2.5$$ עוזר, נקבל ליציבות גבולית.
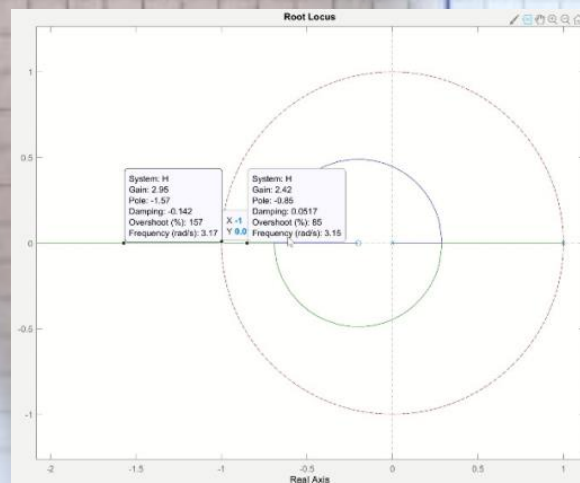
3) Inverse Z transform

(1)
$$\frac{z}{(z^2-3z+2)(z-4)} = \frac{z}{(z-2)(z-1)(z-4)} = \frac{A}{z-2} + \frac{B}{z-1} + \frac{C}{z-4} \quad (E)$$

- $H(z-4)|_{z=4} = C = \frac{4}{2\cdot 3} = \frac{2}{3}$
- $H(z-2)|_{z=2} = A = \frac{2}{+1\cdot(-2)} = -1$
- $H(z-1)|_{z=1} = B = \frac{1}{-1\cdot(-3)} = \frac{1}{3}$

$$(E) \Rightarrow -\frac{1}{z-2} + \frac{1}{3}\frac{1}{z-1} + \frac{2}{3}\frac{1}{z-4} = \frac{-z^{-1}}{(1-2z^{-1})} + \frac{1}{3}\frac{z^{-1}}{(1-z^{-1})} + \frac{2}{3}\frac{z^{-1}}{1-4z^{-1}} \quad /Z^{-1}\}.?$$

$$\Rightarrow -1\cdot 2^{(n-1)}\, u[n-1] + \frac{1}{3}\, u[n-1] + \frac{2}{3}\cdot 4^{(n-1)}\, u[n-1]$$

(2)
$$\frac{3z^2+2z+1}{z^2+3z+2} = \frac{-9\cdot 1}{z+2} + \frac{2\cdot 1}{z+1} = \frac{-9z^{-1}}{1+2z^{-1}} + \frac{2z^{-1}}{1+z^{-1}} \quad /Z^{-1}\}.?$$

$$\Rightarrow -9(-2)^{n-1}\, u[n-1] + 2\cdot(-1)^{n-1}\, u[n-1]$$

(3)
$$\frac{2z}{(2z-1)^2} = \frac{1}{2}\frac{1}{2z-1} + \frac{1}{4}\frac{1}{(2z-1)^2} = \frac{1}{4}\frac{z^{-1}}{1-\frac{1}{2}z^{-1}} + \frac{1}{4}\cdot\frac{1}{4z^2(1-\frac{z^{-1}}{2})^2} =$$

$$= \frac{1}{4}\frac{z^{-1}}{1-\frac{1}{2}z^{-1}} + \frac{1}{16}\frac{z^{-2}}{(1-\frac{1}{2}z^{-1})^2} \quad //Z^{-1}\}.?$$

$$\Rightarrow \frac{1}{4}\left(\frac{1}{2}\right)^{n-1} + \frac{1}{8}(n-1)\frac{1}{4}^{(n-1)} \, u[n-1]$$

$$= \frac{z}{2(z-\frac{1}{2})^2} = \frac{2z^{-1}}{(1-\frac{1}{2}z^{-1})^2} \quad //Z^{-1}\}.?//$$

$$\Rightarrow n\,2^{-n}\, u[n] \quad \Leftarrow$$