1. zh

Diszkrét	Folytonos
$y[k] = \sum_{-\infty}^{\infty} h[i]u[k-i]$	$y(t) = \int_{-\infty}^{\infty} h(\tau)u(t-\tau)d\tau$
$x[k+1] = Ax[k] + Bu$ $y = c^T x + Du$	$x' = Ax + Bu$ $y = c^T x + Du$
$\underline{x}[k] = A^k \underline{x}[0] + \sum_{i=0}^{k-1} A^{k-1-i} \cdot Bu[i]$	$x(t) = e^{At} x(-0) + \int_{-0}^{t} e^{A(t-\tau)} Bu(t) d\tau$
$y[k] = \varepsilon[k] \left(c^T A^k \underline{x}[0] + c^T \sum_{i=0}^{k-1} A^{k-1-i} \cdot Bu[i] + Du[k] \right)$	$y(t) = c^T e^{At} x(-0) + c^T \int_{-0}^{t} e^{A(t-\tau)} Bu(t) d\tau + Du(t)$
$h[k] = \varepsilon[k-1](c^T A^{k-1} B + D\delta[k])$	$h(t) = \varepsilon(t)(c^T e^{At} B + D\delta(t))$
$A^k = \sum_{i=1}^{n} \lambda_i^k L_i$	$e^{At} = \sum_{i=1}^{n} L_i e^{\lambda_i t}$
$L_i = \prod_{\substack{p=1 \\ p \neq i}}^{n} \frac{A - \lambda_p E}{\lambda_i - \lambda_p}$	
$h[k] = \varepsilon[k-1] \left(\sum_{i=1}^{n} \left(\lambda_i^{k-1} c^T L_i B \right) + D\delta[k] \right)$	$h(t) = \varepsilon(t) \left(c^T \left(\sum_{i=1}^{n} L_i e^{\lambda_i t} B \right) + D\delta(t) \right)$

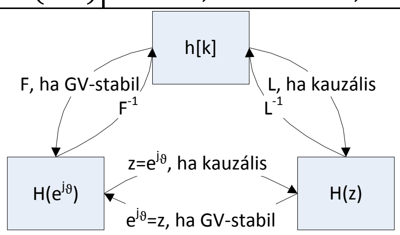
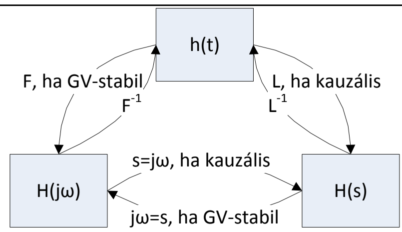
2. zh

Diszkrét	**Folytonos**
Rendszeregyenlet	
$y + a_1 y^{(1)} + a_2 y^{(2)} + \ldots + a_n y^{(n)} = b_0 u + b_1 u^{(1)} + b_2 u^{(2)} + \ldots + b_m u^{(m)}$	$y^{(n)} + a_1 y^{(n-1)} + \ldots + a_{n-1} y^{(1)} + a_n y = b_0 u^{(n)} + b_1 u^{(n-1)} + \ldots + b_n u$
$F(\lambda) = \lambda^n + a_1 \lambda^{n-1} + \ldots + a_{n-1}\lambda + a_n = 0$	
G-V stabilitás	
$\lvert\lambda_i\rvert < 1, \forall i$	$\lambda_i < 0, \forall i$
$1 + a_1 + a_2 + \ldots + a_n > 0$ $1 - a_1 + a_2 - \ldots + (-1)^n a_n > 0$ $\lvert a_n\rvert < 1$	$a_i > 0, \forall i$
Átviteli karakterisztika	
$H(e^{j\vartheta}) = \frac{b_0 + b_1 e^{-j\vartheta} + b_2 e^{-j2\vartheta} + \ldots + b_m e^{-jm\vartheta}}{1 + a_1 e^{-j\vartheta} + a_2 e^{-j2\vartheta} + \ldots + b_n e^{-jn\vartheta}}$	$H(j\omega) = \frac{b_0 (j\omega)^n + b_1 (j\omega)^{n-1} + \ldots + b_{n-1}(j\omega) + b_n}{(j\omega)^n + a_1 (j\omega)^{n-1} + \ldots + a_{n-1}(j\omega) + a_n}$
Szinuszos gerjesztésre adott válasz	
$x[k-1] = x[k] e^{j\vartheta}$	$x'(t) = j\omega x(t)$
$(e^{j\vartheta} I - A)\overline{X} = B\overline{U}$	$(j\omega I - A)\overline{X} = B\overline{U}$
$H(e^{j\vartheta}) = c^T (e^{j\vartheta} I - A)^{-1} B + D$	$H(j\omega) = c^T (j\omega I - A)^{-1} B + D$
$M^{-1} = \frac{adj\ M}{\det M}, ahol\ adj \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} = \begin{bmatrix} a_{22} & -a_{12} \\ -a_{21} & a_{11} \end{bmatrix}$	
$u[k] = U\cos(\vartheta k + \varphi)$ periodikus, ha ϑ π racionális többszöröse	$u(t) = U\cos(\omega t + \varphi)$ mindig periodikus
Periodikus gerjesztésre adott válasz	
$x[k] = x[k-K]$, K minimális egész	$x(t) = x(t-T)$
$u[k] = U_0 + U_1\cos(\vartheta_0 k + \rho_1) + \ldots + U_N \cos(N\vartheta_0 k + \rho_N)$ $\vartheta_0 = \frac{2\pi}{K}$	$u(t) = U_0 + U_1\cos(\omega_0 t + \varphi_1) + U_2\cos(2\omega_0 t + \varphi_2) + \ldots$ $\omega_0 = \frac{2\pi}{T}$
Fourier-sor	
komplex	
$x[k] = \sum_{i=0}^{K-1} \overline{X}_i e^{jik\vartheta_0}$	$x(t) = \sum_{i=-\infty}^{\infty} \overline{X}_i e^{ji\omega_0 t}$
$\overline{X}_i = \frac{1}{K}\sum_{k=0}^{K-1} x[k] e^{-jik\vartheta_0}$	$\overline{X}_i = \frac{1}{T}\int_{-\frac{T}{2}}^{\frac{T}{2}} x(t) e^{-ji\omega_0 t}$
valós	
$x[k] = X_0 + \sum_{i=1}^{\lfloor\frac{K-1}{2}\rfloor} 2\overline{X}_i \cos(i\vartheta_0 k + \varphi_i) + \overline{X}_{\frac{K}{2}}(-1)^k$ ***ha*** *K páros*	$x(t) = X_0 + \sum_{i=1}^{\infty} 2X_i \cos(i\omega_0 t + \varphi_i)$
$\overline{Y}_i = \overline{H}_i \overline{U}_i$ $\overline{Y}_i = Y_i e^{j\rho_i}, \overline{U}_i = U_i e^{j\varphi_i}, \overline{H}_i = H(e^{j\vartheta})\rvert\vartheta = i\vartheta_0$	$\overline{Y}_i = \overline{H}_i \overline{U}_i$ $\overline{Y}_i = Y_i e^{j\rho_i}, \overline{U}_i = U_i e^{j\varphi_i}, \overline{H}_i = H(j\omega)\rvert\omega = i\omega_0$
$y[k] = Y_0 + Y_1\cos(\vartheta_0 k + \rho_1) + \ldots + Y_N\cos(N\vartheta_0 k + \rho_N)$	$y(t) = Y_0 + Y_1\cos(\omega_0 t + \rho_1) + Y_2\cos(2\omega_0 t + \rho_2) + \ldots$

3. zh

Diszkrét	**Folytonos**
Átviteli karakterisztika	
$H(e^{j\vartheta}) = \frac{b_0 + b_1 e^{-j\vartheta} + b_2 e^{-j2\vartheta} + \ldots + b_m e^{-jm\vartheta}}{1 + a_1 e^{-j\vartheta} + a_2 e^{-j2\vartheta} + \ldots + b_n e^{-jn\vartheta}}$	$H(j\omega) = \frac{b_0 (j\omega)^n + b_1 (j\omega)^{n-1} + \ldots + b_{n-1}(j\omega) + b_n}{(j\omega)^n + a_1 (j\omega)^{n-1} + \ldots + a_{n-1}(j\omega) + a_n}$
$H(e^{j\vartheta}) = c^T (e^{j\vartheta} I - A)^{-1} B + D$	$H(j\omega) = c^T (j\omega I - A)^{-1} B + D$
$M^{-1} = \frac{adj\ M}{\det M}, ahol\ adj \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} = \begin{bmatrix} a_{22} & -a_{12} \\ -a_{21} & a_{11} \end{bmatrix}$	
$u[k] = U \cos(\vartheta k + \varphi)$ periodikus, ha ϑ π racionális többszöröse	$u(t) = U \cos(\omega t + \varphi)$ mindig periodikus
Periodikus gerjesztésre adott válasz	
$x[k] = x[k-K]$, K minimális egész	$x(t) = x(t-T)$
$u[k] = U_0 + U_1 \cos(\vartheta_0 k + \rho_1) + \ldots + U_N \cos(N\vartheta_0 k + \rho_N)$ $\vartheta_0 = \frac{2\pi}{K}$	$u(t) = U_0 + U_1 \cos(\omega_0 t + \varphi_1) + U_2 \cos(2\omega_0 t + \varphi_2) + \ldots$ $\omega_0 = \frac{2\pi}{T}$
Fourier-sor	
komplex	
$x[k] = \sum_{i=0}^{K-1} \overline{X}_i\, e^{jik\vartheta_0}$	$x(t) = \sum_{i=-\infty}^{\infty} \overline{X}_i\, e^{ji\omega_0 t}$
$\overline{X}_i = \frac{1}{K} \sum_{k=0}^{K-1} x[k]\, e^{-jik\vartheta_0}$	$\overline{X}_i = \frac{1}{T} \int_{-\frac{T}{2}}^{\frac{T}{2}} x(t) e^{-ji\omega_0 t}$
valós	
$x[k] = X_0 + \sum_{i=1}^{\lfloor \frac{K-1}{2} \rfloor} 2\overline{X}_i \cos(i\vartheta_0 k + \varphi_i) + \overline{X}_{\frac{K}{2}} (-1)^k$ ***ha** K páros*	$x(t) = X_0 + \sum_{i=1}^{\infty} 2X_i \cos(i\omega_0 t + \varphi_i)$
$\overline{Y}_i = \overline{H}_i \overline{U}_i$ $\overline{Y}_i = Y_i e^{j\rho_i}$, $\overline{U}_i = U_i e^{j\varphi_i}$, $\overline{H}_i = H(e^{j\vartheta}) \vert \vartheta = i\vartheta_0$	$\overline{Y}_i = \overline{H}_i \overline{U}_i$ $\overline{Y}_i = Y_i e^{j\rho_i}$, $\overline{U}_i = U_i e^{j\varphi_i}$, $\overline{H}_i = H(j\omega) \vert \omega = i\omega_0$
$y[k] = Y_0 + Y_1 \cos(\vartheta_0 k + \rho_1) + \ldots + Y_N \cos(N\vartheta_0 k + \rho_N)$	$y(t) = Y_0 + Y_1 \cos(\omega_0 t + \rho_1) + Y_2 \cos(2\omega_0 t + \rho_2) + \ldots$
Fourier-transzformáció	
$\mathcal{F}\{f[k]\} = F(e^{-j\vartheta}) = \sum_{k=-\infty}^{\infty} f[k] e^{-j\vartheta k}$, ha f[k] abszolút összegezhető	$\mathcal{F}\{f[k]\} = F(j\omega) = \int_{-\infty}^{\infty} x(t) e^{-j\omega t}\, dt$, ha x(t) abszolút integrálható
$\mathcal{F}^{-1}\{F(e^{-j\vartheta})\} = \frac{1}{2\pi} \int_{-\infty}^{\infty} F(e^{-j\vartheta})\, e^{j\vartheta k}\, d\vartheta$	$\mathcal{F}^{-1}\{F(j\omega)\} = \frac{1}{2\pi} \int_{-\infty}^{\infty} F(j\omega)\, e^{j\omega t}\, d\omega$
$\mathcal{F}\{\delta(t)\} = 1$; $\mathcal{F}\{1\} = 2\pi\delta(\omega)$; $\mathcal{F}\{\varepsilon(t-T) - \varepsilon(t+T)\} = 2T \frac{\sin \omega T}{\omega T}$; $\mathcal{F}\{\varepsilon(t) e^{-\alpha t}\} = \frac{1}{\alpha + j\omega}$	
$\mathcal{F}\{f(t) e^{j\omega_0 t}\} = F(j(\omega - \omega_0)$ modulációs tétel	
$\mathcal{F}\{f(t) * g(t)\} = F(j\omega) G(j\omega)$ konvolúciótétel	
$\Delta\omega_{rendszer} \geq \Delta\omega_{jel}$ torzítatlan átvitel, ahol $\vert H \vert = \left\vert \frac{1}{\sqrt{2}} H_{max} \right\vert$	

4. zh

<table>
<tr><th>Diszkrét</th><th>Folytonos</th></tr>
<tr><td colspan="2">Laplace-transzformáció</td></tr>
<tr><td>$\mathcal{Z}\{x[k]\} = X(z) = \sum_{k=0}^{\infty} x[k]z^{-k}$</td><td>$\mathcal{L}\{x(t)\} = X(s) = \int_{-0}^{\infty} x(t)e^{-st}dt$</td></tr>
<tr><td colspan="2">Fontosabb függvények</td></tr>
<tr><td>$\mathcal{Z}\{\delta[k]\} = 1$</td><td>$\mathcal{L}\{\delta(t)\} = 1$</td></tr>
<tr><td>$\mathcal{Z}\{\varepsilon[k]\} = \frac{z}{z-1}$</td><td>$\mathcal{L}\{\varepsilon(t)\} = \frac{1}{s}$</td></tr>
<tr><td>$\mathcal{Z}\{\varepsilon[k]a^k\} = \frac{z}{z-a}$</td><td>$\mathcal{L}\{\varepsilon(t)t\} = \frac{1}{s^2}$</td></tr>
<tr><td>$\mathcal{Z}\{\varepsilon[k-1]ka^{k-1}\} = \frac{z}{(z-a)^2}$</td><td>$\mathcal{L}\{\varepsilon(t)e^{-\alpha t}\} = \frac{1}{s+\alpha}$</td></tr>
<tr><td>$\mathcal{Z}\{\varepsilon[k]\cos\vartheta_0 k\} = \frac{z^2 - z\cos\vartheta_0}{z^2 - 2z\cos\vartheta_0 + 1}$</td><td>$\mathcal{L}\{\varepsilon(t)\cos\omega_0 t\} = \frac{s}{s^2 + {\omega_0}^2}$</td></tr>
<tr><td>$\mathcal{Z}\{\varepsilon[k]\sin\vartheta_0 k\} = \frac{z\sin\vartheta_0}{z^2 - 2z\cos\vartheta_0 + 1}$</td><td>$\mathcal{L}\{\varepsilon(t)\sin\omega_0 t\} = \frac{\omega_0}{s^2 + {\omega_0}^2}$</td></tr>
<tr><td colspan="2">Tételek</td></tr>
<tr><td>$\mathcal{Z}\{\varepsilon[k-r]x[k-r]\} = z^{-r}X(z)$</td><td>$\mathcal{L}\{\varepsilon(t-\tau)x(t-\tau)\} = X(s)e^{-st}$</td></tr>
<tr><td>$\mathcal{Z}\{c_1x_1[k] + c_2x_2[k]\} = c_1\mathcal{Z}\{x_1[k]\} + c_2\mathcal{Z}\{x_2[k]\}$</td><td>$\mathcal{L}\{c_1x_1[k] + c_2x_2[k]\} = c_1\mathcal{L}\{x_1[k]\} + c_2\mathcal{L}\{x_2[k]\}$</td></tr>
<tr><td>$\mathcal{Z}\{x[k]a^k\} = X\left(\frac{z}{a}\right)$</td><td>$\mathcal{L}\{x(t)e^{at}\} = X(s-a)$</td></tr>
<tr><td>$\mathcal{Z}\left\{\frac{d}{dq}x[k,q]\right\} = \frac{d}{dq}X(z,q)$</td><td>$\mathcal{L}\left\{\frac{d}{dq}x(t,q)\right\} = \frac{d}{dq}X(t,q)$</td></tr>
<tr><td>$\mathcal{Z}\{x[k+1]\} = zX(z) - zx[0]$</td><td>$\mathcal{L}\{x'(t)\} = sX(s) - x(-0)$</td></tr>
<tr><td>–</td><td>$\mathcal{L}\left\{\int_{-0}^{\infty} x(\tau)d\tau\right\} = \frac{1}{s}X(s)$</td></tr>
<tr><td>$x[0] = \lim_{z\to\infty} X(z)$</td><td>$x(+0) = \lim_{\substack{s\to\infty \\ \mathcal{Re}\{s\}>0}} sX(s)$</td></tr>
<tr><td>$x[\infty] = \lim_{z\to 1}(z-1)X(z)$</td><td>$x(\infty) = \lim_{s\to 0} sX(s)$</td></tr>
<tr><td>$\varepsilon[k]x[k] * \varepsilon[k]y[k] = X(z)Y(z)$</td><td>$\varepsilon(t)x(t) * \varepsilon(t)y(t) = X(s)Y(s)$</td></tr>
<tr><td colspan="2">Átviteli függvény</td></tr>
<tr><td>$H(z) = \frac{Y(z)}{X(z)}$, ha u[k] belépő és a rendszer kauzális</td><td>$H(s) = \frac{Y(s)}{X(s)}$, ha u(t)belépő és a rendszer kauzális</td></tr>
<tr><td>$H(z) = \frac{b_0 + b_1z^{-1} + b_2z^{-2} + \cdots + b_mz^{-m}}{1 + a_1z^{-1} + a_2z^{-2} + \cdots + a_nz^{-n}}$, m≤n</td><td>$H(s) = \frac{b_0s^n + b_1s^{n-1} + b_2s^{n-2} + \cdots + b_n}{s^n + a_1s^{n-1} + a_2s^{n-2} + \cdots + a_n}$</td></tr>
<tr><td>$H(z)$
$= K\frac{(z-p_0) + (z-p_1) + (z-p_2) + \cdots + (z-p_m)}{(z-q_0) + (z-q_1) + (z-q_2) + \cdots + (z-q_n)}$, m≤n</td><td>$H(s) = K\frac{(s-p_0) + (s-p_1) + (s-p_2) + \cdots + (s-p_n)}{(s-q_0) + (s-q_1) + (s-q_2) + \cdots + (s-q_n)}$</td></tr>
<tr><td>$H(z) = c^T(zE - A)^{-1}B + D$</td><td>$H(s) = c^T(sE - A)^{-1}B + D$</td></tr>
<tr><td colspan="2">$M^{-1} = \frac{adj\ M}{\det M}, ahol\ adj \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} = \begin{bmatrix} a_{22} & -a_{12} \\ -a_{21} & a_{11} \end{bmatrix}$</td></tr>
<tr><td colspan="2">Rendszerjellemző függvények</td></tr>
<tr><td>$H(z) = H(e^{j\vartheta})\big|e^{j\vartheta} = z$, →GV-stabil, ←kauzális</td><td>$H(s) = H(j\omega)|j\omega = s$, →GV-stabil, ←kauzális</td></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td colspan="2">Speciális rendszerek</td></tr>
<tr><td colspan="2">GV-stabil</td></tr>
<tr><td>$|q_i| < 1\ \forall i$</td><td>$\mathcal{Re}\{q_i\} < 0\ \forall i$</td></tr>
<tr><td colspan="2">minimálfázisú</td></tr>
<tr><td>$|p_i| \le 1, |q_i| < 1\ \forall i$</td><td>$\mathcal{Re}\{p_i\} \le 0, \mathcal{Re}\{q_i\} < 0\ \forall i$</td></tr>
<tr><td colspan="2">mindent áteresztő</td></tr>
<tr><td>$|p_i| > 1, |q_i| < 1\ \forall i$</td><td>$\mathcal{Re}\{p_i\} > 0, \mathcal{Re}\{q_i\} < 0\ \forall i$</td></tr>
</table>