Pochodne:

$c \to 0$

$x \to 1$

$x^n \to nx^{n-1}$

$ax + b \to a$

$ax^2 + bx + c \to 2ax + b$

$\frac{a}{x} = ax^{-1} \to -\frac{a}{x^2} = -1ax^{-2}$

$\sin x \to \cos x$

$\cos x \to -\sin x$

$tgx \to \frac{1}{\cos^2 x}$

$ctgx \to -\frac{1}{\sin^2 x}$

$e^x \to e^x$

$a^x \to a^x \ln a$

$x^x \to x^x(1 + \ln x)$

$\ln x \to \frac{1}{x}$

$\log_a x \to \frac{1}{x \ln a}$

$\sqrt{x} \to \frac{1}{2\sqrt{x}}$

$\sqrt[n]{x} \to \frac{1}{n\sqrt[n]{x^{n-1}}}$

$\sinh x = \frac{e^x - e^{-x}}{2} \to \cosh x = \frac{e^x + e^{-x}}{2}$

$\cosh x = \frac{e^x + e^{-x}}{2} \to \sinh x = \frac{e^x - e^{-x}}{2}$

$\ln(x + \sqrt{x^2 \pm a^2}) \to \frac{1}{\sqrt{x^2 \pm a^2}}$

Funkcje trygonometryczne:

$\sin^2 \alpha + \cos^2 \alpha = 1$

$tg\alpha = \frac{\sin \alpha}{\cos \alpha}$

$ctg\alpha = \frac{\cos \alpha}{\sin \alpha}$

$\sin(\alpha \pm \beta) = \sin \alpha \cos \beta \pm \cos \alpha \sin \beta$

$\cos(\alpha \pm \beta) = \cos \alpha \cos \beta \pm \sin \alpha \sin \beta$

$\sin \alpha \pm \sin \beta = 2 \sin \frac{\alpha \pm \beta}{2} \cos \frac{\alpha \pm \beta}{2}$

$\cos \alpha + \cos \beta = 2 \cos \frac{\alpha + \beta}{2} \cos \frac{\alpha - \beta}{2}$

$\cos \alpha - \cos \beta = -2 \sin \frac{\alpha + \beta}{2} \sin \frac{\alpha - \beta}{2}$

$\sin 2\alpha = 2 \sin \alpha \cos \alpha$

$\cos 2\alpha = 2 \cos^2 \alpha - 1$

$\left|\sin \frac{1}{2}\alpha\right| = \sqrt{\frac{1 - \cos \alpha}{2}}$

$\left|\cos \frac{1}{2}\alpha\right| = \sqrt{\frac{1 + \cos \alpha}{2}}$

$\cos \alpha \cos \beta = \frac{\cos(\alpha - \beta) + \cos(\alpha + \beta)}{2}$

$\sin \alpha \sin \beta = \frac{\cos(\alpha - \beta) - \cos(\alpha + \beta)}{2}$

$\sin \alpha \cos \beta = \frac{\sin(\alpha - \beta) + \sin(\alpha + \beta)}{2}$

$e^{iz} = \cos z + i \sin z$

$\sin \alpha = \cos(\frac{\pi}{2} - \alpha)$

$\cos = \sin(\frac{\pi}{2} - \alpha)$

$tg\alpha = \frac{1}{ctg\alpha}$

$ctg\alpha = \frac{1}{tg\alpha}$

Statyka:
Przestrzenny układ sił

$S_2 = S_1 e^{\mu\varphi}$

Wypadkowe:

$W = \sqrt{W_x^2 + W_y^2 + W_z^2}$

$\cos \alpha = \frac{W_x}{W}, \cos \beta = \frac{W_y}{W}, \cos \gamma = \frac{W_z}{W}$

α, β, γ - kąty które tworzy wypadkowa W z osiami x,y,z

Płaski układ sił:

$W = \sqrt{W_x^2 + W_y^2}$

$tg\alpha = \frac{W_y}{W_x}$

Moment statyczny: środek ciężkości, pole całkowite powierzchni figury płaskiej

$S_x = y_c F,$

$S_{y = x_c F}$

Kinematyka:

$a_s = \frac{dv}{dt}; a_n = \frac{v^2}{\rho}; a = \sqrt{a_s^2 + a_n^2}$

$\varepsilon = \frac{d\omega}{dt} = \frac{d^2\varphi}{dt^2}; \omega = \frac{d\varphi}{dt^2}$

$V = \sqrt{V_u^2 + V_w^2}; V_u = \omega r$

$V = \omega r; \omega = \frac{2\pi}{T}; \omega = \frac{\varphi}{t}$

$a_s = \varepsilon r$

$a_n = \omega^2 R = \frac{V^2}{r}$

$\varepsilon = \frac{\omega}{T}; \varphi = \frac{S}{r}$

$\omega = \frac{2\pi n}{60}; V = \frac{2\pi}{T} R$

$S = Vt$

$S = S_0 + V_0 t \pm \frac{1}{2} a_s t^2$

$f = \frac{1}{T}$

$V = V_0 + at$

$V_b = \sqrt{V_W^2 + V_u^2 + 2V_w + V_u \cos \alpha}; \alpha - kat, miedzy, V_w i V_u$

$a_c = 2\omega V_\omega$

Dynamika:

$F = ma$

Prędkość pkt.: $V = V_0 + \frac{F}{m} t$

Równanie ruchu: $r = r_0 + v_0 t + \frac{F}{2m} t^2$

$F + P_b = 0$

$P_b = -ma$

$dL = Pdr$

Sprężyna: $P = -kx; x - wydluzenie$

$G = mg$

$P = k \frac{m_1 m_2}{r^2}; k = 5{,}67 \cdot 10^{-11} \frac{m^3}{kg \cdot s^2}$

Moc: $N = \frac{dL}{dt} = \frac{Pdr}{dt} = Pv$

$dL = Ndt$

$l_{12} = \int_1^2 Ndt; L = \int Pdr$

Sprawność: $\eta = \frac{N_u}{N_W} = \frac{L_u}{L_W}$

Nr- moc użyteczna
Nw- moc własna

Pęd: $p = mv = \frac{dS}{dt}$

S-moment statyczny

Kręt: $k = r \cdot p = r \cdot m \cdot u$

Moment krętu: $M = \sum r_k \times P_k; M = \frac{dk}{dt}$

$E_k = \frac{mv^2}{2}$

$E_k = E_{kc} + \frac{1}{2} m v_c^2$

$E_{k2} - E_{k1} = L_z + L_w$

$E_{k1} + E_{p1} = E_{k2} + E_{p2}$

$E_p = L = mgh$

Wahadło: $\varepsilon = \frac{d^2\varphi}{dt}; \omega = \frac{2\pi}{T}; T = 2\pi\sqrt{\frac{l}{g}}$

Równanie ruchu: $\frac{d^2\varphi}{dt^2} + \omega^2\varphi = 0$

$l = \frac{I}{md}$

Tw.Steinera: $I_x = I_{xc} + ma^2$

$B = ma = \frac{P}{g} \cdot \frac{v^2}{R}$

Wytrzymałość:

Macierz stanu napężenia: $\delta_{xy} = \begin{bmatrix} \sigma_x & \tau_{xy} \\ \tau_{yx} & \sigma_y \end{bmatrix}$

Naprężenia główne: $\sigma^2 - s_I \sigma + s_{II} = 0$

$s_I = \sigma_x + \sigma_y; s_{II} = \det \sigma_{xy}$

Kierunek: $\left[\sigma_{xy} - I\sigma_z\right] \cdot [\mu_2] = [0]$

$[\mu_2] = \begin{bmatrix} L_1 \\ m_2 \end{bmatrix}; l_2^2 + m_2^2 = 1$

Macierz stanu odkształcenia:

$\xi_{xyz} = \begin{bmatrix} \varepsilon_x & \frac{1}{2}\gamma_{xy} & \frac{1}{2}\gamma_{xz} \\ \frac{1}{2}\gamma_{yx} & \varepsilon_y & \frac{1}{2}\gamma_{yz} \\ \frac{1}{2}\gamma_{zx} & \frac{1}{2}\gamma_{zy} & \varepsilon_z \end{bmatrix}$

$\varepsilon_x = \frac{1}{E}\left[\sigma_x - v(\sigma_z + \sigma_y)\right]$

$\varepsilon_y = \frac{1}{E}\left[\sigma_y - v(\sigma_x + \sigma_z)\right]$

$\varepsilon_z = \frac{1}{E}\left[\sigma_z - v(\sigma_x + \sigma_y)\right]$

$\frac{1}{2}\gamma_{xy} = \frac{1 + v}{E} \cdot \tau_{xy}$

Macierz stanu naprężenia:

$\sigma_{x_1 y_1} = A^T \sigma_{xy} A$

$A = \begin{bmatrix} \cos 45 & -\sin 45 \\ \sin 45 & \cos 45 \end{bmatrix}$

$\xi = \begin{bmatrix} \varepsilon_x & \frac{1}{2}\gamma_{xy} \\ \frac{1}{2}\gamma_{yx} & \varepsilon_y \end{bmatrix}$

$\varepsilon^2 - \varepsilon \cdot e_I + e_{II} = 0$

$e_I = \varepsilon_x + \varepsilon_y; e_{II} = \det \xi_{xy}$

$\sigma_{xy} = \begin{bmatrix} \sigma_x & \tau_{xy} \\ \tau_{yx} & \sigma_y \end{bmatrix}$

$\sigma_x = \lambda\varepsilon + 2G\varepsilon_x$

$\lambda = \frac{vE}{(1 - 2v)(1 + v)}; \tau_{xy} = G\gamma_{xy}$

$\varepsilon = \frac{1}{3}(\varepsilon_x + \varepsilon_y); G = \frac{E}{2(1 + v)}$

$\sigma^3 - \sigma^2 s_I + \sigma s_{II} - s_{III} = 0$

$s_I = \sigma_x + \sigma_y + \sigma_z$

$s_{II} = \begin{vmatrix} \sigma_x & \tau_{xy} \\ \tau_{xy} & \sigma_y \end{vmatrix} + \begin{vmatrix} \sigma_y & \tau_{yz} \\ \tau_{yz} & \sigma_z \end{vmatrix} + \begin{vmatrix} \sigma_z & \tau_{zx} \\ \tau_{zx} & \sigma_x \end{vmatrix}$

$s_{III} = \det[\sigma_{xyz}]$

$G = \frac{E}{2(1 + v)}$

$\tau \max = \frac{M_s}{W_s}$

$W_s = 0{,}2d^3 koło I_s = 0{,}1d^4$

$W_s = 0{,}2d(1 - \alpha^4)$

$\varphi = \frac{M_s l}{GI_s}$

Otwarty:

$\varphi = \frac{M_s l}{GI_s}$

$I_s = \frac{1}{3}(b \cdot \delta^3); \tau_{\max} = \frac{M_s}{I_s} \cdot \delta_{\max}$

Zamknięty:

$\tau_{\max} = \frac{M_s}{2A \cdot \delta_{\min}}$

$I_s = \frac{4A^2}{\frac{s}{\delta}}$

Steiner: $I = I_x + Sa^2$

$\sigma_{red} = \sqrt{\frac{1}{2}\left[(\sigma_x - \sigma_y)^2 + (\sigma_y - \sigma_z)^2 + (\sigma_z - \sigma_x)^2 + 3(\tau_{xy}^2 + \tau_{yz}^2 + \tau_{zx}^2\right]}$

$\sigma_{red} = \sqrt{\sigma_x^2 + \sigma_y^2 - \sigma_x\sigma_y + 3\tau_{xy}^2}$

$\sigma_{\max} = \frac{\sigma_x + \sigma_y}{2} + \sqrt{(\frac{\sigma_x - \sigma_y}{2})^2 + \tau_{xy}}$

$\tau_{\max} = \sqrt{(\frac{\sigma_x - \sigma_y}{2})^2 + \tau_{xy}^2} = \frac{\sigma_{\max} - \sigma \min}{2}$

$\sigma_{g \max} = \frac{M_{g \max}}{I_{zc}} \cdot \rho_{\max}$

$I_{zc} = I_z - y_c^2 A; \tau_{\max} = \frac{T_{\max} S}{I_{zc} u(zc)}$

$tg 2\varphi gł = \frac{2\tau_{xy}}{\sigma_x - \sigma_y}$

$tg 2\varphi_s = \frac{\sigma_y - \sigma_x}{2\tau_{xy}}$