MECH 321 **EQUATION SHEET**

$U_r = \frac{\sigma_y^2}{2E}$ $\varepsilon_T = ln\left(\frac{l_i}{l_o}\right)$ $\varepsilon_{eng} = \left(\frac{l_i - l_o}{l_o}\right) = \frac{\Delta l}{l_o}$ $\sigma_T = k\varepsilon_T^n \ (uniform\ plastic)$

$\sigma_T = \sigma(1+\varepsilon)$ $\varepsilon_T = ln(1+\varepsilon)$ $\sigma_y = \sigma_o + kd^{-1/2}$ $\%\ Cold\ work = \left(\frac{A_o - A_d}{A_o}\right)x100$

$\tau = \frac{M_T r}{J}$ $\gamma = \frac{r\theta}{L}$ $\tau_r = \sigma cos\lambda \cos\theta$ $\rho_c = V_f\rho_f + (1-V_f)\rho_m$ $L_c = \frac{\sigma_f d}{2\tau_c}$

$E_{c1} = E_f V_f + E_m V_m$ $E_{c2} = \frac{E_f E_m}{E_f(1-V_f)+E_m V_f}$ $\sigma_{cd}^* = \sigma_f^* V_f\left(1 - \frac{l_c}{2l}\right) + \sigma_m'(1-V_f)$

$\sigma_{cd'}^* = \frac{l\tau_c}{d}V_f + \sigma_m'(1-V_f)$ $\sigma_{cl}^* = \sigma_f^* V_f + \sigma_m'(1-V_f)$ $\sigma_{c2} \approx \frac{\sigma_m}{2}$

$\sigma_{max} = 2\sigma_o\left(\frac{a}{\rho}\right)^{1/2}$ $K_T = \frac{\sigma_{max}}{\sigma_o}$ $\sigma_c = \sqrt{\frac{2E\gamma_s}{\pi a}}\ (brittle)$ $\sigma_c = \sqrt{\frac{2E(\gamma_s+\gamma_p)}{\pi a}}\ (plastic)$

$G_c = \frac{K_{1c}^2}{E}$ $K_{1c} = Y\sigma\sqrt{\pi a}$ $B \geq 2.5\left(\frac{K_{1c}}{\sigma_y}\right)^2$

$\sigma_{amplitude} = \frac{\sigma_{range}}{2} = \frac{\sigma_{max}-\sigma_{min}}{2}$ $\sigma_{mean} = \frac{\sigma_{max}+\sigma_{min}}{2}$ $\sigma_{range} = \sigma_{max} - \sigma_{min}$

$\frac{da}{dN} = A(\Delta K)^m \ \ where \ \ \Delta K = Y(\sigma_{max} - \sigma_{min})\sqrt{\pi a}$

$N_f = \int_{a_o}^{a_c}\frac{da}{A(Y\Delta\sigma\sqrt{\pi a})^m} = \frac{1}{A\pi^{m/2}(\Delta\sigma)^m}\int_{a_o}^{a_c}\frac{da}{Y^m a^{m/2}}$ $\sigma_{thermal} = \alpha E\Delta T$

$\dot{\varepsilon} = Ae^{-Q/RT} = k\sigma^n e^{-Q/RT}$ $P_{(Larson-Miller)} = T(C + \log t)$

$\Delta V = (V_2^o - V_1^o) - \frac{RT}{nF}ln\left[\frac{M_1^{n+}}{M_2^{n+}}\right]$ $\Delta V = (V_2^o - V_1^o) - \frac{0.0592}{n}\log\left[\frac{M_1^{n+}}{M_2^{n+}}\right]$ $CPR = \frac{KW}{\rho At}$

$\boldsymbol{r} = \frac{\boldsymbol{i}}{\boldsymbol{nF}}$

Constants

R= 8.314 $J.mol^{-1}.K^{-1}$ F = 96,500 $C.mol^{-1}$ $N_A = 6.023 \times 10^{23}$ molecules/mole