Collection of often used MEMS formulas.

Accelerometers		
Mass displacement	$x \approx \frac{m\ddot{x}_f}{k} = \frac{\ddot{x}_f}{\omega_0^2}$	36
Input rererred rms-noise	$\ddot{x}_{\text{rms}} = \sqrt{\frac{\omega_0^2 k_B T}{m}}$	42
Beam optics		
Beam width	$w(z) \approx \frac{\lambda z}{\pi w_0}$	266
Spreading angle	$\theta_0 \approx \frac{\lambda}{\pi w_0}$	266
Capacitance		
Parallel plate	$C = \epsilon \frac{A}{d-x}$	226
Capacitor charge	$Q = CV$	160
Capacitive actuation		
General equation	$F_e = -\frac{\mathrm{d}W_e}{\mathrm{d}x} = \frac{1}{2}V^2\frac{\mathrm{d}C}{\mathrm{d}x}$	226
Parallel plate	$F_e = \frac{1}{2}\frac{\epsilon A}{(d-x)^2}V^2$	226
Comb drive	$F_e = \epsilon N \frac{h}{2d} V^2$	232
Pull-in displacement	$X_P = \frac{1}{3}d$	228
Pull-in voltage (one sided)	$V_P = \sqrt{\frac{8}{27}\frac{kd^3}{\epsilon_0 A}}$	229
Pull-in voltage (two sided)	$V_P = \sqrt{\frac{1}{2}\frac{kd^3}{\epsilon_0 A}}$	238
Transduction factor	$\eta = V_{\text{dc}}\frac{\partial C}{\partial x} \approx V_{\text{dc}}\epsilon\frac{A}{d^2}$	234
Energy		
Thermal	$W = \frac{1}{2}k_B T$	20
Capacitor	$W = \frac{1}{2}CV^2$	20
Inductor	$W = \frac{1}{2}Li^2$	20
Spring	$W = \frac{1}{2}kx^2$	24
Inertial	$W = \frac{1}{2}m\dot{x}^2$	23
Fluidic		
Flow resistance	$R = \frac{8\mu L}{\pi r^4}$	373
Reynold's number	$\text{Re} = \frac{\rho\dot{x}L}{\mu}$	372
$p_{\min}$ to move bubble	$p_c = \frac{2\gamma}{r}$	374
Gas damping		
Couette damping	$\gamma = \frac{\mu_{\text{eff}}A}{d}$	192
Knudsen number	$K_n = \frac{\lambda}{d_c}$	186
Mean free path	$\lambda = \frac{RT}{\sqrt{2}\pi d_g^2 N_A p}$	185
Squeeze film damping	$\gamma_{\text{gas}} = 0.42\frac{\mu_{\text{eff}}A^2}{d^3}$	188
Gyroscopes		
Coriolis force	$\vec{F}_c = -2m\vec{\Omega} \times \vec{\dot{x}}$	347
Noise (matched modes)	$\Omega_{\text{rms}} = \frac{1}{2Q_s x_d}\sqrt{\frac{k_B T}{m}}$	360
Noise (separated modes)	$\overline{\Omega} = \frac{\sqrt{2}F_{n,s}}{2m_d\omega x_d}$	360
Harmonic resonator		
Low-f displacement	$x \approx \frac{F}{k}$	411
Quality factor	$Q = \frac{\omega_0 m}{\gamma} = \frac{\sqrt{km}}{\gamma}$	410
Resonance frequency	$\omega_0 = \sqrt{\frac{k}{m}}$	410
Resonant displacement	$x = -j\frac{QF}{k}$	411

Material properties		
Quality factor (scaling)	$f \cdot Q = \text{constant}$	179
Strain	$S = \frac{\Delta L}{L}$	52
Stress	$T = \frac{F}{A}$	52
Young's modulus	$E = \frac{T_{XX}}{S_{XX}}$	52
Thermal expansion	$S = \alpha\Delta T$	252
Microresonator		
Motional capacitance	$C_m = \frac{\eta^2}{k}$	323
Motional current	$i_{\text{mot}} = \eta\dot{x}$	93
Motional inductance	$L_m = \frac{m}{\eta^2}$	323
Motional resistance	$R_m = \frac{\sqrt{km}}{Q\eta^2}$	323
MOS transistor		
$1/f$-noise	$\overline{v_{1/f}^2} = \frac{K}{C_{ox}WL}\frac{1}{f}$	140
Input capacitance	$C_{\text{in}} = C_{ox}WL$	131
Noise	$\overline{v_{n,\text{in}}^2} = \frac{4k_B T\gamma_c}{g_m}$	141
Transconductance	$g_m = \sqrt{2\mu_n C_{ox}\frac{W}{L}I_D}$	131
Piezoresistance		
$1/f$-noise	$\bar{v}_n = \sqrt{\frac{\alpha}{fN}}V$	85
Gauge factor	$GF = \frac{\Delta R/R}{S} \approx E\pi$	74
Piezoresistivity coefficient	$\pi = \frac{\Delta\rho/\rho}{T}$	74
Resistor resistance	$R = \rho\frac{L}{A}$	74
RF switch		
Capacitive (shunt)	$\lvert S_{21}\rvert^2 = \frac{1}{1+(\omega CZ_0/2)^2}$	295
Series (resistive)	$\lvert S_{21}\rvert^2 = \left\lvert\frac{2Z_0}{2Z_0+R}\right\rvert^2$	300
Switching time	$t = \sqrt{\frac{27}{2}\frac{V_P}{V_s\omega_0}}$	301
Springs		
Hooke's law	$F = kx$	50
Second moment of inertia	$I = \frac{ab^3}{12}$	59
Cantilever	$k = \frac{3EI}{L^3}$	60
Capacitive	$k_{0e} = -\frac{V^2 C_0}{(d-x_0)^2}$	231
Guided beam	$k = \frac{12EI}{L^3}$	64
Rod	$k = \frac{EA}{L}$	58
Torsional ($b < a$)	$k_\theta \approx G\frac{ab^3}{3L}$	62
Springs, parallel	$k_{\text{tot}} = k_1 + k_2$	50
Springs, series	$\frac{1}{k_{\text{tot}}} = \frac{1}{k_1} + \frac{1}{k_2}$	50
Thermal noise		
Current spectral density	$\overline{i_n^2} = \frac{4k_B T}{R}$	22
Rms displacement	$x_{\text{rms}} = \sqrt{\frac{k_B T}{k}}$	24
Force spectral density	$\overline{F_n^2} = 4k_B T\gamma$	24
Rms voltage	$v_{\text{rms}} = \sqrt{\frac{k_B T}{C}}$	20
Voltage spectral density	$\overline{v_n^2} = 4k_B TR$	21

Note: the number after the formulas corresponds to a page in *Practical MEMS* book.