Medical Imaging: **Formula Sheet 2011-2012**

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- You will get this formula sheet in the exam
- If a formula in the lecture handouts is NOT on this sheet it is either:
    - Considerably more complicated and does not need to be memorized. NOTE: This formula may be part of an exam question and you still need to understand what it means. If it is required in the exam it will be provided as part of the question. For example, you are not expected to remember definitions for Fourier Transforms.

  or

    - You need to know it. If the derivation was performed in class or as part of a worked exercise then you should be prepared to repeat this in the exam.

Maths:

$$P_n = \frac{\mu^n}{n!} e^{-\mu}$$

$$F_{HI} = \frac{-1}{\pi x} * f(x)$$

X-ray:

$$E_n = -\frac{Z^2 m_e e^4}{8\varepsilon_0{}^2 h^2 n^2} = -13.6 \frac{Z^2}{n^2} \text{eV}$$

$$P_r \approx 0.9 \times 10^{-9}.IZV^2$$

$$E_{sc} = \frac{E_i}{1 + \frac{E_i}{m_e c^2}(1 - \cos\theta)}$$

X-ray CT:

$$f'(x,y) = \frac{1}{N} \sum_{i=1}^{N} p'(x\cos\phi_i + y\sin\phi_i, \phi_i)$$

$$\Im[p(r,\phi)] = P(\xi,\phi)$$

$$P'(\xi,\phi) = H(\xi) P(\xi,\phi)$$

Ramp (Ram-Lak) filter $H(\xi) = \frac{|\xi|}{\xi_{\text{max}}}$

$$CT_{\#} = 1000 \times \frac{\mu_{tissue} - \mu_{water}}{\mu_{water}}$$

Gamma camera parallel hole collimator:

$$\delta r_{\text{coll}} = d \, \frac{(l + 2z)}{l}$$

$$G = \frac{d^4}{12 l^2 (d+t)^2}$$

$$\tau = \frac{N - n}{nN}$$

PET:

$$R_{\text{true}} = R_{\text{positron}} \varepsilon^2 (2G)$$

$$R_{\text{randoms}} = R_{\text{s1}} R_{\text{s2}} 2\tau$$

OCT:

$$\Delta z = \frac{2\ln 2}{\pi}\frac{\lambda_0{}^2}{\Delta\lambda}$$

$$2z_R \approx 2\frac{\lambda}{\pi NA^2}$$

$$f_D = 2\frac{v_R - v_S}{\lambda_0}$$

Ultrasound:

$$-\frac{\partial p}{\partial x} = \rho_0\frac{\partial v}{\partial t}$$

$$-\frac{\partial \rho}{\partial t} = \rho_0\frac{\partial v}{\partial x}$$

$$\frac{\partial^2 p}{\partial t^2} = \frac{\beta}{\rho_0}\frac{\partial^2 p}{\partial x^2}$$

$$\langle E\rangle = 2\pi^2\rho_0 f^2\xi_0^2$$

$$\langle I\rangle = \langle E\rangle c = \frac{1}{2}\rho_0 c\omega^2\xi_0^2$$

$$\tau = \frac{4Z_0Z_T}{(Z_L + Z_0\, Z_T/Z_L)^2}$$

$$G = \frac{\pi a^2}{\lambda F}$$

$$df = \frac{-2fv\cos\theta}{c}$$

$$f = \frac{1}{2\pi R}\sqrt{\frac{3\gamma P_0}{\rho_0}}$$

$$f = \frac{1}{2\pi R}\sqrt{\frac{3\gamma P_0 + 12G_s\, d_s/R}{\rho_0}}$$

$$\rho\left(R\ddot{R} + \frac{3\dot{R}^2}{2}\right) - \left(P_L - P_\infty\right) = 0$$

MRI:

$$\frac{d\vec{M}}{dt} = \gamma\left(\vec{M}\times\vec{B}\right) + \frac{M_0 - M_z(t)}{T_1} - \frac{M_{xy}(t)}{T_2^*}$$

$$\frac{\delta B}{B_0} = \frac{B_{max} - B_{min}}{B_0}\times 10^6$$

$$M_z = \frac{M_0\left(1 - e^{-\frac{TR}{T_1}}\right)}{1 - \cos\alpha . e^{-\frac{TR}{T_1}}}$$

$$M_{xy} = \frac{M_0\left(1 - e^{-\frac{TR}{T_1}}\right)}{1 - \cos\alpha . e^{-\frac{TR}{T_1}}}\sin\alpha$$