1. Write a complete system description for the instrument function of a planar x-ray imager (assume scanned fan beam). Include:
   - Finite size source
   - Heal effect on source intensity and energy spectrum
   - Oblique angle effects
   - Depth dependent magnification
   - Quantum efficiency and PSF for the scintillator/photographic plate.

2. For a cylindrical object (long axis perpendicular to the beam) calculate the profile of X-ray intensity in a fan beam geometry, assuming that the beam is mono-energetic.

3. Calculate the effect of beam hardening on the CT image of a disk.

4. For the following sample, show (a.) the projections and (b.) the filtered projections
4. A sinusoidally modulated x-ray image is recorded by a one-sided screen film system as shown below. Find the recorded S/N as a function of frequency, where the signal is the sinusoidal component and the noise is the average background. On average the screen produces \( l \) photons per x-ray photon, \( t \) of which are transmitted to the emulsion where \( r \) is recorded. The pixel area of the film is much smaller than the system resolution. Neglect any critical angle effect between the screen and the film.

X-ray photon number as a function of \( z = n_0 \cos(2 \pi k z) \).

5. Write a program that calculates the Radon transform of an object function, then Fourier filters the projects, and finally reconstructs an image via back projection.