Homework 2
Due date: November 24, 2023

1. Identify which of the following crystal planes belong to the [111] crystal zone: (1-10), (231), (2-31), (2-11), (101), (13-3), (112), (132), (01-1), (-212)).

2. How do aberrations in electromagnetic lenses occur? How do we eliminate and reduce aberrations?

3. Explain the key factors affecting the resolution of optical microscopes and electromagnetic lenses. How can we improve the resolution of electromagnetic lenses?

4. For electron probe microanalysis, what are the advantages and disadvantages of wave and energy spectrometers?

5. What is the extinction distance? What are the main physical parameters and external conditions that affect the extinction distance of a crystal?

6. Use figures to illustrate the principle of diffraction contrast imaging and explain the bright field image and a dark field image.

7. It is known that the diffraction intensity expression of diffraction contrast kinetic theory is:

$$I_D = \left(\frac{\pi}{\xi_g}\right)^2 \frac{\sin^2(\pi t s_{eff})}{(\pi s_{eff})^2} \quad I_T = 1 - I_D$$

In the formula, where s is the deviation parameter and ξg is the extinction distance. Please discuss the phenomena of equal thickness extinction and equal tilt extinction and compare it with the kinematic theory.