APPENDIX A: NANO SE QUALIFYING EXAMINATION STUDY GUIDANCE

Study Items for NANO-PhD Qualifying Exam: **NANO 701**:

1. Aerosol processes and aerosol characterization.
2. Size distribution functions.
3. Particle motion in external fields.
4. Particle growth in molecular and continuous regimes.
5. Nucleation theory and critical cluster size.
6. Growth mechanisms.
7. Effect of particle size on melting temperature and equilibrium of heterogeneous reactions.
8. Collision and coagulation.
9. Self-preserving size distribution
10. Nanoparticle synthesis techniques.
11. Thin film deposition techniques.
12. Atomic layer deposition technique.
13. Growth termination and nanoparticle stabilization.
14. Sol-gel method.
15. Nanocrystalline powder consolidation processes.

Study Items for NANO-PhD Qualifying Exam**: NANO 702**:

1. Be able to solve the 1-D Schrödinger's eqtn, per notes, homework and exam problems.
2. Understand the eigenvalue problem as it relates to electronic, vibronic and photonic response of materials, per the homeworks and exam problems.
3. Understand the consequences of periodicity on the description of electronic, vibronic and photonic properties of materials, be able to determine and interpret dispersion relations for waves in periodic systems per homework and exams.
4. Understand the basic operational principles behind scanning probe microscopies and their relation to the model of a simple harmonic oscillator. Calculate the response of a model system to a harmonic input and understand the effect of varying model parameters, per homework and exam problems.
5. Be familiar with the scaling of classical and quantum systems to nanometer dimensions, and their applications. For instance, the scaling of electronic transitions in semiconductor nanoparticles, and the phenomena of plasmon resonances in metallic nanoparticles.

Study Items for NANO-PhD Qualifying Exam**: NANO 703/703L**:

1. Understand the basic concept of wave-particle duality as related to electrons and photons. Be able to compute the wavelength at a particular energy.
2. Know Scherrer's formula and be able to estimate particle size based on x-ray diffraction peak width.
3. Given the lattice constant for a cubic crystal and the occupied atomic sites within the unit cell, know how to compute the crystal structure factor for a reciprocal lattice vector **g** with miller indices *hkl* and identify any systematically absent reflections.
4. Know how to measure *d*-spacings from an electron diffraction pattern and how to analyze the Fourier transform computed from an image of a periodic structure.
5. Familiarize yourself with and be able to identify basic crystallographic symmetry operations and elements: rotations, reflections, inversions, translations, screw axes, and glide planes.