Physics 471 - Study guide for exam 2
Dr Colton, Winter 2024

- Chapter 4 – Three Materials, Two Interfaces (the part that wasn't covered on exam 1)
    - How to use the matrix method to determine transmission and reflection for a multilayer stack
- Chapter 5 – Crystals
    - Biaxial – Given n_x, n_y, and n_z, and a direction of travel, how to determine the index of refraction for the two main polarizations…
        - If traveling in x, y, or z, how to get the answers trivially
        - If traveling in a different direction, how to solve the Fresnel crystal equation to determine this (although if one polarization is in x, y, or z, it's still trivial for that polarization)
    - What are the "optic axes"—how to determine and what they mean
    - Uniaxial – Given n_o and n_e, and especially for the particular orientation where the optic axis points along the plane of the interface, and for both s and p polarizations…
        - What is the "fast axis"
        - Given a direction of travel, how to determine the index of refraction
        - How to determine the direction of the k-vector
        - How to determine the direction of the Poynting vector
- Chapter 6 – Jones & Stokes/Mueller
    - What Jones vectors mean, how to determine them for a given situation
    - What Jones matrices mean, how to use them to determine the effect of various optical elements on the Jones vector
    - What Stokes vectors mean, how to determine them for a given situation
    - What Mueller matrices mean, how to use them to determine the effect of various optical elements on the Stokes vector
    - How to connect the vectors to quantities such as overall intensity
    - Behavior of some common configurations such as quarter wave plate at ±45°, half waveplate at angle θ
- Chapter 7 – Fourier and Dispersion
    - How to determine phase and group velocities for a material given its dispersion relation and a given set (or range) of frequencies
    - What are Fourier transforms—how to calculate them for basic cases, and what they mean
    - What are delta functions—basic properties, how to use them, and what they mean
    - What are convolutions—how to calculate them and what they mean
        - What are the convolution theorems and how to use them
    - Linear dispersion – what impact it has on a pulse traversing a medium, how to calculate effects such as:
        - speed of travel
        - time delay
        - reduction of amplitude from absorption
    - Quadratic dispersion – what impact it has on a pulse traversing a medium, how to calculate effects such as:
        - speed of travel
        - spreading out of pulse in time
        - reduction of amplitude (from absorption but also from spreading out)
        - pulse chirping (qualitative only)