Syllabus for the full semester class:

Lab #	Subject
1	***Introduction to optical imaging*** Topics: Getting an image; magnification, focal length, imaging at finite & infinite conjugates with a digital camera. Introduction to rail-mount optical breadboard system.
2	***Camera set-up and resolution*** Topics: Setting up lens on camera, imaging at infinite conjugates. Assembling optical rail, imaging a resolution target and investigation of interplay between resolution and contrast.
3	***Building a simple compound microscope; Aberrations and calibration.*** Topics: Examine the imaging quality of different lens orientations and type, and investigate the effects of using different colors of light. Use a test target to calibrate system magnification.
4	***Setting up controlled illumination*** Topics: Kohler illumination and conjugate planes. Set up field and aperture stops, investigate the relation between the condenser aperture, illumination uniformity and intensity, and image resolution. Investigate meaning of conjugate planes by inserting objects in the optical path.
5	***Introduction to Abbe Theory (I): Kohler illumination, Darkfield contrast, Resolution*** Topics: Further investigate Kohler illumination, and use it to allow set-up of oblique illumination and central darkfield contrast. Explore effects of illumination and manipulation of the objective back focal plane on resolution; use darkfield to see point-spread function using sub-resolution beads.
6	***Introduction to Abbe Theory (II): Image formation*** Topics: Set up a second camera imaging the objective back focal plane (BFP), and use this and the sample-plane camera to examine conjugate planes. Using coherent illumination and gratings, investigate effect of objective NA on resolution while observing diffracted orders in the BFP. Explore impact of spatial filtering in the BFP on the image of a grid sample.
7	***Introduction to Abbe Theory (III):Resolution, illumination, and the MTF*** Topics: Examine effects of line spacing in a Ronchi ruling on the spacing of diffracted orders in the objective BFP, along with the effect of illumination wavelength on the positions of the orders and resolution of the image. Use variable frequency Ronchi rulings to explore the MTF using incoherent and coherent illumination, and derive the same information from the edge and line-spread functions.
8	***Introduction to Abbe Theory (IV): Contrast*** Topics: Brightfield and darkfield contrast; exploration of signal-to-background. Effect of illumination NA on resolution and contrast. Set up and explore effects of phase contrast.
9	***Fluorescence (I)*** Topics: Set up fluorescence microscopy in a transmitted-light geometry. Explore effect of filters, examine fluorescence emission, image a sample.