PHE503 : Advanced Optics

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Books:
- Pedrotti, F.L., « *Introduction to Optics* », 3rd edition, Pearson.
- Hecht, E., « *Optics* », 4th edition, Addison-Welsey.

Marking Scheme :		
	50%	Assignments
	10%	Final project presentation
	40%	Final project written paper

Assignment #1: Geometrical optics
Assignment #2: Designing a Lyot-Ohman polarization filter.
Assignment #3: Slab waveguide
Assignment #4: Diffraction and surface plasmon resonance

For the final project, you must write a review paper (30 to 40 pages double-spaced) on the topic of your choice in optics and photonics. You must pre-approve your topic with the instructor before starting your work. A list of possible topics will be given to you in class.

"Academic misconduct, including plagiarism, cheating and other violations of the academic code of conduct, is a serious offense for which penalties have a range from formal warnings to dismissal. The RMCC regulations concerning academic misconduct, Section 23, defines plagiarism as follows: "Using the work of others and trying to pass it off as his/her own, or, among others, not crediting a source, wrong source quote, and the misuse of the quotation marks to reference a source". This also includes "Failure to acknowledge that work has already been presented elsewhere to obtain credit." All students should consult the rules published on academic misconduct in the undergraduate calendar of the Royal Military College of Canada, Section 23. "

The student is assumed to have taken a senior undergraduate course in optics (PHE/F307 or equivalent), otherwise, remedial course notes for PHE307 will be given to the student to study.

Course Outline

	Subject
Review 1: Geometrical optics	
1	Matrices method for paraxial optics
2	Matrices notation for geometrical optics
3	Matrices examples
Review 2: Wave optics	
4	Maxwell's equations and EM waves
5	Poynting's theorem
6	Irradiance
Review 3: Polarization	
7	Types of polarizations
8	Dichroism and birefringence
9	Jones vectors and matrices
Chapter 1: EM propagation in anisotropic media	
10	Dielectric tensor for anisotropic crystals
11	Plane wave propagation in anisotropic crystals
12	The optical index ellipsoid
13	Pockels' linear electro-optic effect
14	Crystals
15	Kerr's quadratic electro-optic effect
16	Examples for a KDP crystal
Chapter 2: Second harmonic generation in crystals	
17	Second order susceptibility
18	Pulsed laser beams
19	EM formulation of non-linear interactions
20	Optical second harmonic generation
21	Experimental examples
Chapter 3: Fabry-Pérot interferometer	
22	Physical description and the finesse factor
Chapter 4: Waveguide optics	
23	Propagation condition
24	EM treatment
25	Gratings as waveguide couplers
26	Finding the refractive index with coupled mode theory
Chapter 5: Surface Plasmon Resonance	
27	Metal optics

28	Plasmon-polaritons
29	Classification of materials
30	Drude model for dielectric permittivity
31	Dispersion relation of plasmons
32	Propagation and penetration lengths
33	Surface plasmon excitation conditions
Chapter 6: Introduction to Fourier optics (If time permits)	
34	Fourier transforms
35	Applications of Fourier transforms
36	Convolution theorem and its applications