**Imaging optics**

**Cursus**

- Génie électrique et électronique MA2, MA4 Opt.
- Microtechnique MA2, MA4 Obl.
- Photonics minor E Opt.

**Summary**

Introduction to optical imaging systems such as camera objectives and microscopes. Discussion of imaging formation. Principles of design of imaging optics with geometrical optics and analysis with raytracing. Presentation of different applications in photography and microscopy.

**Content**

- Light: electro-magnetic waves, scalar theory
- Statistical optics: temporal and spatial coherence
- Fourier optics representation of imaging
- Imaging Fundamentals of geometrical optics - Matrix Method - thick lenses - system concept
- Image quality - Point-spread function and optical transfer functions
- Ray-tracing - aberrations
- Detection of light: noise and detectors
- Microscopy: dark field, phase and polarization contrast, confocal, fluorescence
- Optical design (hands on ray-tracing)

**Keywords**

Optical imaging, optical instruments, optical design, performance analysis, aberrations, resolution and contrast, microscopy

**Learning Prerequisites**

**Required courses**
- Micro 321 Ingénierie optique I
- Micro 322 Ingénierie optique II
- Micro 420 Selected topics in advanced optics
- Analysis IV, Linear algebra, General physics III/IV

**Recommended courses**
- Signals and systems, Image processing

**Important concepts to start the course**
Matrix calculations, Fourier transformation, Electromagnetic waves, refraction and reflection, polarization, signal filtering, basics of geometrical optics

Learning Outcomes
By the end of the course, the student must be able to:
• Sketch optical systems
• Estimate performance of optical systems
• Analyze imaging systems and the image quality
• Characterize the elements of imaging systems

Transversal skills
• Set objectives and design an action plan to reach those objectives.
• Communicate effectively with professionals from other disciplines.
• Continue to work through difficulties or initial failure to find optimal solutions.

Teaching methods
Lecturing with exercises

Assessment methods
• Oral exam: drawing a question to prepare, expose and discuss
• No support allowed.

Supervision
Office hours No
Assistants Yes
Forum No
Others Possible to take dates

Resources
Virtual desktop infrastructure (VDI)
No

Bibliography
B.A. Saleh and M.C. Teich, Fundamental of photonics (2007)

Bibliography
• Handbook of Optical Systems Vol.1 / Gross
• Handbook of Optical Systems Vol.4 / Gross
• Introduction to Fourier optics / Goodman
• Fundamental of photonics / Saleh

Notes/Handbook
Course material and slides covering geometrical and matrix optics, Fourier optics, microscopy are published on Moodle