

MICRO-421

**Imaging optics**

Psaltis Demetri

<b>Cursus</b>	<b>Sem.</b>	<b>Type</b>
Electrical and Electronical Engineering	MA2, MA4	Opt.
Life Sciences Engineering	MA2, MA4	Opt.
Mechanical engineering	MA2, MA4	Opt.
Microtechnics	MA2, MA4	Opt.
Minor in Imaging	E	Opt.
Photonics minor	E	Opt.
Photonics		Opt.

Language of teaching	English
Credits	3
Withdrawal Session	Unauthorized Summer
Semester Exam	Spring During the semester
Workload Weeks	90h 14
<b>Hours</b>	<b>3 weekly</b>
Lecture	2 weekly
Exercises	1 weekly
<b>Number of positions</b>	

**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
- Image quality - Point-spread function and optical transfer functions
- Detection of light: noise and detectors
- Microscopy: dark field, phase and polarization contrast, fluorescence
- Optical design ; beam propagation code
- Holography, tomography, 3D imaging, confocal

**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  
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

During semester evaluation. Final written exam in the last day of class.

### 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)  
J.W. Goodman, Introduction to Fourier optics (1996)

#### Ressources en bibliothèque

- [Fundamental of photonics / Saleh](#)
- [Introduction to Fourier optics / Goodman](#)

#### Notes/Handbook

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

**Moodle Link**

- <https://go.epfl.ch/MICRO-421>