

# Lectures on Optical microsystems

## by Prof. Christophe Gorecki

First lecture: around November 1, 2021. The whole course consists of 15 lecture hours.  
Registration deadline: Oct. 22; please send an e-mail to [cgorecki@ichf.pl.edu](mailto:cgorecki@ichf.pl.edu) .

### 1. Optical Microsystems: Introduction

Introduction and terminology  
Basics of Microoptics  
Basics of MEMS  
What are MOEMS?  
Fabrication of Microoptics  
Fabrication of MEMS and MOEMS  
Packaging and assembly of Microsystems  
What's inside a MOEMS: two examples  
Key parts, devices and applications of Optical Microsystems  
Conclusion and challenges  
Bibliography

### 2. Microoptics for Optical Microsystems

Classification of micro-optical elements  
Refractive and diffractive optical elements  
Reflective optical elements  
Focus on diffractive microoptics  
Important properties of microoptical components  
Basics of guided-wave microoptics

### 3. MEMS passive structures and actuators

Review of passive MEMS structures  
Review of MEMS actuators  
Electrostatic actuators  
Thermal actuators  
Magnetic actuators  
Piezoelectric actuators

### 4. Optical Microsystems: Fabrication Technologies

#### Part 1: Microfabrication for Microoptics

Lithography techniques  
Laser writing  
Half tone and gray tone techniques  
Replication technologies  
Fabrication of binary and multilevel micro-optics  
Microoptics made by melting and reflow technologies

#### Part 2: Micromachining technologies

Fabrication on silicon wafer  
Patterning and photolithography  
Thin film deposition  
Etching technologies  
The bulk micromachining and surface micromachining  
Micromachining of channel waveguides

### 5. Microsystem Packaging

Introduction and terminology  
MEMS/MOEMS packaging  
Wafer bonding technologies  
Hermetic packaging  
Making electrical connections  
Optical packaging with fiber to waveguide coupling  
Conclusions

### 6. Optical Microsystems: Applications

Introduction  
Stacked and planar microoptics  
Miniature light sources  
Scanning micromirrors  
MEMS Optical displays  
DMD mirrors  
Grating Light Valve  
MEMS Optical modulators  
Optical MEMS switches  
Optical MEMS multiplexers  
Case study of a Swept-source OCT microsystem  
Silicon Microoptical bench  
Other Optical MEMS sensors  
Conclusion

### 7. Testing of Optical Microsystems

Introduction  
MEMS/MOEMS metrology  
-Material and mechanical characterization  
-Surface characterization  
-contact techniques  
-no-contact techniques  
Metrology of High Aspect Ration MEMS

Generalities on MEMS reliability  
Example of reliability study  
Conclusions  
Bibliography

