Optics (1160210) Spring - 2025

Lectures: Sunday 9:30-11:30, Lidow building, lecture hall 323
Tuesday 9:30-10:30, Lidow building, lecture hall 323

Tutorials: Sunday 11:30-12:30, room to be announced (Ilay)
Tuesday 14:30-15:30, room to be announced (Nevo)

Course staff:

Lecturer: Dr. Michael Krueger, Solid State building, room 222
krueger@technion.ac.il
Reception hour: Tuesday 10:30-11:30

TAs: Ilay Paran, Solid State building, room 200
ilay.paran@campus.technion.ac.il
Reception hour: Will be determined in the first tutorial meeting

Nevo Werner-Reiss, Solid State building, room 212
nevo@campus.technion.ac.il
Reception hour: Will be determined in the first tutorial meeting

Syllabus:

1. EM waves in matter: Maxwell equations and EM waves in dielectric medium, velocity of light in matter, boundary conditions, reflection and refraction. Snell's law and Fresnel equations. Critical angle, Brewster angle, total internal reflection and evanescent waves. 2 *weeks.*
2. Geometrical optics: Eikonal equation and Ray equation. Fermat's principle of least time, ray matrix method, image formation, optical elements (mirrors, lenses, etc), optical instruments (telescope, microscope, magnifying lens, optical fibers). *2 weeks.*
3. Wave optics: The full and paraxial Helmholtz equations, gaussian beams solutions, gaussian optics, depth of focus, beam quality, gaussian matrix method, higher order gaussian modes. *2 weeks.*
4. Fourier optics: Spectral decomposition, transfer function, propagating waves and the diffraction limit, spatial light modulation, Fresnel and Fraunhofer approximations, Huygens-Fresnel principle, optical Fourier transform, imaging systems and spatial filtering. *3 weeks.*
5. Diffraction theory: Boundary conditions and Green functions, Fresnel-Kirchhoff diffraction theory, Rayleigh-Sommerfeld diffraction theory, diffraction from circular and rectangular apertures. The diffraction limit and optical resolution. *2 weeks.*
6. Advance topics (according to the time remaining in the semester): wave-particle dualism, interferometers and holography, optical coherence, aberrations, caustics. *2 weeks.*

Text books and supporting materials:

1. Fundamentals of Photonics, B. Saleh and M. C. Teich.
2. Optics, Eugene Hecht.
3. The Feynman lectures on Physics.
4. Principles of Optics, Max Born and Emil Wolf.
5. Introduction to Fourier Optics, Joseph W. Goodman.
6. Physics of light and optics, J. Peatross and M. Ware, http://optics.byu.edu/textbook.aspx
7. Supporting materials that can be downloaded from the course website.

Grading:

Homework (mandatory!): 20% of final grade - the best 8 exercises will be taken into consideration (including justified causes).

Final Exam: 80% of final grade.

MOED A – Tuesday, 12/8/2025, MOED B – Friday, 5/9/2025