OPTICS

1. KEY INDICATORS

CFU/ECTS: 6
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2. OBJECTIVES OF THE COURSE

The optics course will give specific and deep knowledge's on the light, on its behaviours amd on the most important passive and active devices to elaborate it. The classes are devoted to a deep insight on the light propation through waves, analyzing the interference and diffraction phenomena. In geometric optics regime, the most important optical components and systems will be introduced and deeply investigated, both passive ones or emitting ones like lasers. Guided optics will be also investigated. Advanced elements of optical design will be also introduced.

3. ACQUIRED ABILITIES

The student will learn the fundamental principles of optics and optical design. He will learn those materials applied in optics and how to organise and optical set□up. He/she will be able to design advanced devices of specific applications.

4. PROGRAM OF THE COURSE

Electromagnetic waves and light: generalities Maxwell equations and EM waves. Poynting vector and light energy. Lightning quantities. Fermat principle and Snell Law. Fresnel coefficients. Absorbing, dispersive and emitting systems and media. Sellmeier equation and Abbe table for glasses. Geometric Optics Short wavelength approximation. Reflection and mirrors. Refraction and dioptric surfaces. Thin lenses. Centred optical systems. Thick lenses. Aberrations Thin lens aberration. Achromatic doublet. Spherical aberration from a single surface. Aplanatic lenses. Astigmatism.
Guided optics Guided waves through total reflection. Planar waveguide. Propagation modes and phase conditions. TE (pol□s) and TM (pol□p) modes. Optical fibres. Numerical aperture. Chromatic and modal dispersions. Propagation, diffraction and interference Plane wave development, Evanescent waves. Continuous and pulses light beams. Phase and group velocities. Huygens□Fresnel principle and Helmholtz□ Kirchhoff formula. Near field and far field diffraction. Diffraction grating. Spectral resolution. Interferometry. Fabry□Perot resonator. Paraxial approximation. Anisotropic Media Index Ellipsoid. Uniaxial and biaxial crystals. Dichroism. Quarter and half wavelength plates. Light polarisation. Nonlinear Optics Nonlinear response. Anharmonic oscillator. Second order effects. The nonlinear optical tensor. Optical harmonic generation. Parametric effects. Acousto□optic effect and optical modulators. The Pockels electro□ optic effect. Electro□optic modulators. Photorefractivity and self□assembling optical structures. Spatial solitons and Kerr third order nonlinearity. Photorefractive spatial solitons.

5. REFERENCES

E. Fazio, Oscillatori e Onde, Ed. Esculapio
K.D. Moller, Optics 2nd edition, Ed. Springer
F. Gori, Elementi di Ottica, Ed. Accademica

6. WEBSITE OF THE COURSE

www.sbai.uniroma1.it