

Syllabus

JML 229: Fundamentals of Optics (310)

Instructor: Prof. Ranjan Datta

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1. A brief history of light

Beginning, historical development of optics. (2 hrs.)

2. The Electromagnetic approach

Maxwell's equations, Poynting vector, wave equations, phase and group velocity, reflection and refraction, refractive index, Rayleigh Scattering, Fresnel's formula, reflection and transmission coefficients, Brewster's law, energy and momentum, dielectric films, electromagnetic potentials and polarization, dispersion. (9 hrs.)

3. Geometrical Optics

Foundation of geometrical optics, Fermat's principle, Gaussian optics, thin and thick Lenses, ray tracing, optical imaging, geometrical aberrations, various image forming instruments and components, Abbe's theory, physiological optics. (9 hrs.)

4. Wave Optics

Various types of waves, superposition principle, Elements of the theory of interference and interferometers, Elements of the theory of diffraction, Fresnel and Fraunhofer diffraction, diffraction gratings, diffraction theory of aberrations, partially coherence light, Fourier optics, coherence theory, holography. (9 hrs.)

5. Optics of Materials

Optics of metals, theory of Mie, optics of crystals, double and conical refraction, dispersion, Zeeman effect, phase and group velocity, Nicol prism, compensators, absorption, polarizers, dichroism, birefringence, Liquid crystal. (6 hrs.)

6. Optics of moving media

Measurement of velocity of light, Fresnel's coefficient of drag and Fizeau's experiment, The Michelson experiment. (3.5 hrs.)

7. Quantum Optics

Light sources, Light quanta, photon spectrum, Lasers, Holography, magneto and electro optics, dual nature of light, Nonlinear optics, photonics. (3.5 hrs.)

Total 42 hours in 14 weeks

References:

1. *Principles of Optics*, by Born and Wolf
2. *Fundamentals of Optics*, by Jenkins and White
3. *Optics* by Eugene Hecht
4. *Optics* by Arnold Sommerfeld