

Indian Institute of Technology, Kanpur

Proposal for a New Course

1. Course No: SPA 698X
2. Course Title: Optical Instrumentation for Astronomy
3. Lectures per week: 3 (L), Tutorial: 0 (T), Laboratory: 0 (P), Additional hours: (0-2): 0 (A), Module Credits ($3*L+2*T+P+A$): 9, Duration of Course: Full Semester
4. Proposing Department: Space Planetary & Astronomical Sciences & Engineering (SPASE)
5. Proposing Instructor: Prashant Pathak
6. Course Description

(A) Objectives: The course aims to introduce basic optics and then go into advance topics of optical design for astronomical telescopes and various instruments such as imagers, spectrographs. The course will also introduces high-angular resolution techniques such as adaptive optics and interferometry.

(B) Contents (preferably in the form of 5 to 10 broad titles):

1. **General Optics:** Refraction, Reflection, and Transmission, Polarization, Brewster Angle and Total Internal Reflection, Aberrations, Diffraction, Point-Spread Function, Modulation Transfer Function, Spectral Transfer Function. (10-lectures)
2. **Optical Systems:** Pupils and Images, Convolution, Optical Design Principles, Design Approach, Ray Tracing and spot diagrams, Optimization, Tolerance Analysis, Stray Light Control and Baffles. Diffractive Analysis, Fourier Optics, Introduction to OSLO (optical design software) and designing instruments and telescopes using it. (12-lectures)
3. **Adaptive Optics:** Atmospheric turbulence and its effects on astronomical image formation, Sources of turbulence, Kolmogorov model of turbulence. Derivations of optical effects of turbulence: wavefront error, Fried parameter. Wavefront Sensors, Deformable Mirrors, Adaptive Optics Control, Laser Guide Stars, Operation Modes. (10-lectures)
4. **Interferometry:** Interferometer Principle and Angular Resolution, Delay Lines, Beam Combiners, Fringe Visibility, Fringe Tracking and Closure Phase, Aperture Synthesis and (u,v) Plane, Field of View and Sensitivity. (8-lectures)

(C) Pre-requisites: SPA613M

(D) Short summary for including in the Courses of Study Booklet: The course aims to introduce basic optics and then go into advance topics of optical design for astronomical telescopes and various instruments such as imagers, spectrographs. The course will also introduces high-angular resolution techniques such as adaptive optics and interferometry.

7. Recommended Books:

- Optics by Eugene Hecht.
- Astronomical Optics: D. J. Schroeder, 1999.
- Introduction to Fourier Optics, by Joseph Goodman (McGraw Hill, 1996)
- Principles of Adaptive Optics, fourth edition, by Robert K. Tyson, (CRC Press, 2015)

8. Any other remarks:

Dated: Proposer:

Dated: DUGC/DPGC Convener:

The course is approved/not approved

Chairman, SUGC/SPGC

Dated: