# Indian Institute of Technology, Kanpur
# Proposal for a New Course

1. Course No: SPA634

2. Course Title: Applied Optics: From Rays to Waves

3. Lectures per week: 2(L), Tutorial: 0(T), Laboratory: 2(P), Additional hours: (0-2): 0(A), Module Credits (3*L+2*T+P+A): 8, 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 instruments such as imagers, spectrographs. The ideas and concepts of geometric optics will be developed through a series of exercises involving OSLO. Concepts of wave optics will be demonstrated through exercises using Python.

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

   1. **Geometrical Optics:** Modeling light as rays, Bending of light: reflection and refraction, Imaging systems and ray transfer matrices, Magnification of optical instruments, Aperture stops: aberration reduction, Depth of focus, Telecentricity, Aberrations: chromatic, monochromatic (Seidel). (12-lectures)
   2. **Diffractive/scalar wave optics:** Light as waves: 1D & 3D wave equation, Plane & Spherical waves, Double-slit experiment, Diffraction gratings, Grating spectrometry, Point-Spread Function. Fourier optics: FT, FT of images, FT for far-field diffraction, Airy disk, and resolution limit, FT and convolutions, Modulation Transfer Function, Spectral Transfer Function. Aberrations as wavefront errors (Zernike polynomials). Coherence: spatial and temporal. (14-lectures)
   3. **Ray** & **Wave Optic Simulations:** Introduction to OSLO (optical design software), and designing optical systems using it by covering the topics: Pupils and Images, Optical Design Principles, Design Approach, Ray Tracing and spot diagrams, Optimization, Tolerance Analysis, Stray Light Control and Baffles. And wave-optics simulations. (14-lectures)

   (C) Pre-requisites: None

   (D) Short summary for including in the Courses of Study Booklet: Starting from the basics of optics, this course guides students into advanced optical design concepts relevant to instruments such as imagers and spectrographs. Through interactive exercises using OSLO and Python, students will develop both geometric and wave optics understanding with practical, design-oriented applications.

7. Recommended Books:

   - Optics by Eugene Hecht.
   - Astronomical Optics: D. J. Schroeder, 1999.
   - Introduction to Fourier Optics, by Joseph Goodman (McGraw Hill, 1996)

8. Any other remarks:

Dated: Proposer:

Dated: DUGC/DPGC Convener:

The course is approved/not approved

Chairman, SUGC/SPGC

Dated: