

Indian Institute of Technology, Kanpur Proposal for a New Course

1. Course No: SPA201
2. Course Title: Introduction to Astronomy and Astrophysics
3. Lectures per week: 3 (L), Tutorial: 0 (T), Laboratory: 0 (P), Additional hours: (0-2): 0 (A), 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: Sharvari Nadkarni-Ghosh/Pankaj Jain/Amitesh Omar
6. Course Description
 - (A) Objectives: The course aims to introduce students to basic ideas and concepts in modern Astronomy & Astrophysics.
 - (B) Contents (preferably in the form of 5 to 10 broad titles):
 1. **Historical Introduction** (2 lectures)
History of Astronomy (ancient Indian and Greek astronomy), Constellations & Nakshtras, magnitude scale, Parallax
 2. **Astrometry** (6 lectures)
Celestial Sphere, Coordinates, Rise, set, and tracks of celestial objects, Precession, Basic calculations, Introduction to Calendars, Seasons on Earth, Eclipses & Transits, Hands-on sessions using Stellarium, cosmic distance ladder.
 3. **Universal Physical Principles and basics of radiation** (6 lectures)
Newton's law of Gravitation, Conservation of energy and momentum, Electromagnetic Spectrum, Thermal radiation, Continuum and spectral line emission, examples of radiation from astrophysical sources
 4. **Observing tools** (6 lectures) Types of telescopes, signal & noise, sources of noise, signal to noise ratio, Gaussian & Poisson statistics, detection probabilities.
 5. **Our Solar system and other exoplanets** (6 lectures)
Kepler's laws and objects in the solar system, Planetary Atmospheres, Planetary Rings, exoplanets - detection methods.

6. **Structure and life-cycle of stars** (6 Lectures)
 Source of energy, Hydrostatic Equilibrium, Mass loss, Evolution (colour-magnitude, HR diagram), Star birth, Planetary nebulae, Novae, Supernovae, Gamma-Ray Bursts, Binary Stars, White dwarfs, Brown dwarfs, Neutron stars, Black holes,
7. **Milky-Way, extra-galactic astrophysics and cosmology** (8 Lectures)
 Structure of Milky-Way, Types of galaxies, nearby galaxies, Kinematics, Dark matter, redshift measurements, galaxy clusters, Physical conditions in Interstellar Medium & Intergalactic Medium, Tracers of interstellar medium, hands-on session using galaxy kinematics data, basic introduction to cosmology, dark matter and dark energy

(C) Pre-requisites, if any: None.

(D) Short summary for including in the Courses of Study Booklet:
 This course will provide a foundation to UG students in the area of astronomy & astrophysics. Topics include a historical introduction, astrometry, universal physical principles and basics of radiation, observing tools, solar system and exoplanets, stellar structure and evolution, milky way and other galaxies, and basic introduction to cosmology

7. Recommended Books:

- The Cosmic Perspective - Bennet, Donahue, Schneider, Voit.
- Introduction to Astronomy and Astrophysics - Pankaj Jain
- Descriptive Archaeoastronomy and Ancient Indian Chronology - Amitabha Ghosh
- The Physical Universe - Frank Shu
- Foundations of Astronomy - Michael A Seeds

8. Any other remarks:

Dated: Proposer:

Dated: DUGC/DPGC Convener:

The course is approved/not approved

Chairman, SUGC/SPGC

Dated: