

Indian Institute of Technology, Kanpur Proposal for a New Course

1. Course No: SPA610A
2. Course Title: Fundamentals of Astronomy and Astrophysics
3. Lectures per week: 3 (L), Tutorial: 0 (T), Laboratory: 0 (P), Additional hours: (0-2): 0 (A), Credits ($3*L+3*T+P+A$): 9, Duration of Course: Full Semester
4. Proposing Department: Space Science & Astronomy
5. Proposing Instructor: Pankaj Jain
6. Course Description
 - (A) Objectives: The course aims to introduce students to fundamentals of Astronomy and Astrophysics. It will cover topics such as, multi-frequency astronomical observations, Astrometry, Photometry, Stellar structure and evolution, interstellar medium, Galaxies and the Milky Way, Introduction to Cosmology It will be offered as a compulsory course in the Radio Astronomy M.Tech. stream and as an elective for students of all branches.
 - (B) Contents (preferably in the form of 5 to 10 broad titles):

S. no.	Broad Title	Topics	No. of lectures
1.	Overview	Night sky, constellations, Retrograde motion of planets, Sidereal time, Kepler's laws, Virial Theorem	5
2.	Observations	Electromagnetic Spectrum, Observations at visible frequencies, Resolution, Seeing, Telescope mounts, Interferometry, observations at other wavelengths, cosmic rays	5
3.	Astrometry	coordinate systems used in Astronomy, coordinate transformation, proper motion, Doppler effect, Aberration, precession of equinoxes	6
4.	Photometry	Intensity and Flux density, Blackbody radiation, magnitude scale, color index, stellar temperatures, Radiation from astronomical sources, Bremsstrahlung, Synchrotron Radiation, Compton Scattering, Radiative Transitions/line-emission, Radiative transfer	5
5.	Stars and Stellar evolution	Stellar spectra, Saha equation, Hertzsprung-Russell (HR) diagram, Star clusters and Associations, Stellar structure, pressure and temperature gradient, energy production, Rosseland mean opacity, equation of state, radiative pressure, stellar nuclear reactions, nuclear reaction rate, standard solar model, star formation and stellar evolution, evolution beyond the main sequence, white dwarfs, neutron stars and black holes, supernova explosion	12
6.	Binary stars	Kinematics of binary star system, Classification of binary stars, Mass Determination	4
7.	Milky Way	Distribution of matter in the Milky Way, Differential Rotation, Mapping the Galactic Disk, Formation of spiral arms	4
8.	Galaxies	Classification of galaxies, Evidence for dark matter, Galaxy Clusters, Large scale structure of Universe	3

(C) Pre-requisites, if any: N/A

(D) Short summary for including in the Courses of Study Booklet:
Historical introduction to astronomy, Multi-wavelength Observations, Astrometry, Coordinate systems, Photometry, Radiation from astronomical sources, Radiative transfer, Stellar spectra, Saha equation, HR diagram, Stellar Structure, Stellar nuclear reactions, Star formation and stellar evolution, Compact stars, Supernova explosions, Binary star systems, Milky Way galaxy, Introduction to galaxies, Large scale structure of the Universe

7. Recommended Books:

- An Introduction to Astronomy and Astrophysics, P. Jain
- An Introduction to Modern Astrophysics, Bradley W Carroll and Dale A Ostlie

8. Any other remarks:

Dated: Proposer:

Dated: DUGC/DPGC Convener:

The course is approved/not approved

Chairman, SUGC/SPGC

Dated: