

ASTRONOMY, ASTROPHYSICS AND COSMOLOGY

Overview:

In this course, students will be exposed to basic principles, ideas and mathematics involved in cosmology, astronomy and astrophysics. It will also involve learning and using MATLAB and Mathematica to simulate some fascinating results. We will also teach them how to use DS9, an astronomical data analysis tool, to arrive at conclusions on some of the astonishing realisations like Hubble's law, spectral analysis of electromagnetic radiation from distant celestial objects. We will make them know the developments in all three fields so far and their current status. Also future possible interesting explorations they can do based on the course.

Instructors:

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Topics:

- Introduction
 - Special theory of relativity
 - General theory of relativity
 - Historical review of cosmology and it's developments.
 - Standard model of cosmology and Inflation.
 - Large scale structure and Perturbations
 - Contemporary problems of cosmology.
 - Historical review of astronomy and it's developments.
 - Light curves and associated conclusions.
 - Exoplanets.
 - Spectral Analysis
 - Dark Matter
 - Celestial mechanics
 - Introduction:
 - Newton's laws of motion and gravity
 - Kepler's laws
 - Theoretical basics:
 - Central forces
- } Week 1 & 2
- } Week 3 & 4
- } Week 5
- } Week 6 & 7
- } Week 8 & 9

- Hamilton-jacobi theory
 - The lagrange planetary equations
 - Mathematical and computational:-
 - Numerical methods
 - Conic sections
 - Plane and Spherical Trigonometry
 - The celestial sphere
 - The two body problem in two dimensions
 - Computation of an ephemeris
 - Calculation of orbital elements
 - Visual and spectroscopic binary stars
 - Orbital maneuvers
 - What causes Orbital perturbations
 - Historical review of astrophysics and it's developments.
 - Stellar evolution and HR diagram.
 - Compact objects.
- } Week .9 & 10
- } Week 11 & 12
- } Week 13
- } Week 14 & 15

Evaluative Components:

- 2 Assignments - 30%
- 3 Quizzés - 40%
- Comprehensive exam - 30%

References:

- An introduction to Celestial Mechanics - Richard Fitzpatrick
- Orbital Mechanics (3rd edition) - Vladimir A Chobotov
- Orbital and Celestial Mechanics - J. Vinti, G. Der and A. Bonavito
- Spacetime and Geometry: An Introduction to General Relativity- Sean Carroll
- General Relativity - Robert M Wald
- Principles of Physical Cosmology - P. J. E. Peebles
- Introduction to Cosmology - Jayant V Narlikar