Course: M.Sc (Physics)

Semester:	4
Paper Number	17 (MPHC4453)
Paper Title	Observational and Computational Astrophysics Lab
No. of Credits	6
Course description/objective	**Group A:** This course aims at exposing a student to the basics of observational astronomy, in particular optical astronomy. It also aims to expose students to data analysis and data fitting and parameter estimation, in problems of astronomy and cosmology. This course also aims to expose students to some basic solar observations. **Group B:** The aim of this course is to introduce the students to the essential of computational astronomy and astrophysics. Building on their previous exposure on python and Octave, the students learn to make use of astronomical libraries, do data analysis and learn to formulate the n-body problem of celestial dynamics.
Course Outcome	**Group A** **Observational Astrophysics** CO1: Develops understanding and skills related to the basic observational tools in optical astronomy, specially photometry CO2: Develops understanding of solar phenomena like limb darkening CO3: Learn about astronomical data analysis through simple exercises CO4: Learn about cosmological parameter estimation **Group B** **Computational Astrophysics** CO1: Handle astronomical data CO2: Work with astronomical libraries CO3: Apply computational and visual techniques to astrophysical problems. CO4: Formulate and study the N-body problem of astrodynamics.

Syllabus	**<u>Group A:</u>** **Observational Astronomy** **[36 Lectures]** Introduction to Optical Telescopes, Stellar Photometry and Spectroscopy: CCD based photometers and detectors. List of Experiments (tentative): 1. To estimate the temperatures of an artificial star by photometry. 2. To study the solar limb-darkening effect. 3. To study the effective temperature of stars by B-V photometry. 4. To determine the solar constant using the principle of calorimetry. 5. To study the Fraunhofer absorption lines from the solar photosphere. 6. Analysing SN1a data to determine the deceleration parameter and the Hubble parameter of the universe. 7. Determination of the height of lunar mountains. 8. Night observations using a 14 inch telescope at Fr. Eugene Lafont Observatory (stellar photometry and stellar spectrometry) 9. Radio Data Analysis (tentative) ● Hands on experience: Visit to facilities in and around Kolkata and outside Kolkata (subject to availability of accommodation). Note: Observations will depend on weather conditions. **<u>Group B:</u>** **Computational Astrophysics** **[36 Lectures]** Planetary Dynamics, Chaos, Spherical Accretion Models, Stellar Structure and Stellar Atmosphere (radiative transfer), Cosmological distances, Age of the Universe.
References	**<u>Group A:</u>** **Observational Astronomy** 1.Astronomy: A physical perspective by M. L. Kutner (CUP, 2003) 2. Astronomical Techniques by Kitchin **<u>Group B:</u>** **Computational Astrophysics** 1.Numerical Methods in Astrophysics: An Introduction (Series in Astronomy and Astrophysics Book 12) by Peter Bodenheimer, Gregory P. Laughlin,Michal Rozyczka, Tomasz Plewa, Harold. W Yorke, Harold W. Yorke

	2. Computational Physics by Nicholas Giordano and Hisao Nakamishi (Prentice Hall) 3. An Introduction to Modern Astrophysics by B. W. Carrol and D. A. Ostlie (Pearson, 2006)
Evaluation	Total: 100 Group A: CIA: 30 (10 (LNB) + 20 (CIA Exam)) Group B: CIA: 30 (10 (LNB) + 20 (CIA Exam)) End Semester Examination: 20 (Group A) + 20 (Group B)