

Indian Institute of Technology, Kanpur

Proposal for a New Course

1. **Course No:** SPA6XX M

2. **Course Title:** The Dynamics of Milky Way and Local Group of Galaxies

3. **Lectures per week:** 3 (L), Tutorial: 0 (T), Laboratory: 0 (P), Additional hours: (0-2): 0 (A), Credits ($3*L+0*T+0*P+0*A$): 5, Duration of Course: Half Semester Modular Course

4. **Proposing Department:** Space, Planetary and Astronomical Sciences and Engineering (SPASE)

5. **Proposing Instructor:** Sandeep Kumar Kataria, Amitesh Omar

6. Course Description:

a. Objectives: Galaxies are fundamental building blocks of the large scale structure in our Universe. This course deals with fundamental principles governing the dynamics of disk (i.e. Milky Way/Andromeda), elliptical (i.e. Sagittarius, M87) and dwarf galaxies (i.e. LMC/SMC) etc. Further, the course aims to provide familiarity with observations and numerical simulations techniques used in the galactic dynamics.

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

i. Introduction and Fundamentals [1 lectures]: Overview of galaxies: morphology, kinematics and basic properties; Milky Way and local group of galaxies.

ii. Potential theory [3 lectures]: Spherical density distribution, potential-density pairs of flattened system, potential of our Galaxy (Milky Way)

iii. Orbits of stars [2 lectures]: Orbits in a given galactic potential (spherical/elliptical, axisymmetric/non-axisymmetric etc.), numerical orbit integration methods

iv. Equilibria of Collisionless Systems [4 lectures]: Boltzmann equation, Jeans theorem, distribution functions, Jeans and Virial equations: asymmetric drift, Virial theorem and related observations

v. Disk Dynamics and non-axisymmetric instabilities [5 lectures]: Linear response theory, global stability of differentially rotating disk, fundamentals of spiral structures, bars, bending waves, warping and buckling of disk

vi. Collisions and encounter of stellar systems [2 lecture]: Dynamical friction, mergers

vii Contemporary open problems in galactic dynamics [4 lecture]: Perspective of observations and simulations (idealized and cosmological simulations)

c. Pre-requisites, if any: N/A d.

d. Short summary for inclusion in the Courses of Study Booklet: Fundamentals of Galactic Dynamics, Orbits of stars in a range of potentials, Disk instabilities i.e. Spirals, bars and warps, Applications to contemporary observational data and numerical simulations

7. Recommended Books:

[1] J. Binney & M. Merrifield: Galactic Astronomy

[2] J. Binney & S. Tremaine: Galactic Dynamics

[3] H. Mo, F. van den Bosch, S. White: Galaxy Formation and Evolution

[4] T. Padmanabhan: Theoretical Astrophysics Volume II: Stars and Stellar Systems

8. Any other remarks:

Dated:

Proposer:

Dated:

DUGC/DPGC Convener:

The course is approved/not approved
Chairman, SUGC/SPGC

Dated: