PHY690X - Introduction to Planetary Astrophysics (Sem-I, 2026-2027)

1. No. of Lectures per week: 3 (L), Tutorial: 0 (T), Laboratory: 0 (P), Additional Hours[0-2]

   Credits: 09 Duration of Course: Full Semester

2. Instructor: Gopal Hazra (PHY)
3. Course Description:

   (A) Objectives: This course is intended to introduce basics of planetary astrophysics to the master's and advanced undergraduate students with a background in basic physics and astronomy. The course will emphasize on fundamentals of planet formation, migration. It will also introduce orbital dynamics and how we detect planets outside of our solar system. The interior and lower atmosphere of planets and how their host star affect their structure will be thoroughly discussed. Details of course structure is given below.

   B) Contents:

S. No.	Broad Title	Topics	No. of Lectures
1.	**Dynamical and Physical Properties of Planets and Exoplanets**	(a) The cosmic context of Planets - Overview of solar system planets, exoplanets and their demographics, - Are newly discovered exoplanets different than our solar system planets? (b) Orbital Dynamics, migration and Chaos (N-body Problems, stability, resonances) (c) Detection Techniques - Radial Velocity, Transit Photometry, direct imaging, microlensing	**8**
2.	**How do Planet form and evolve? Are they different from star formation?**	(a) Planet formation Theories - Core Accretion, Disk Instability, Pebble Accretion (b) Dynamical Evolution of planetary Orbit - Disk planet interaction, migration, planet-planet scattering (c) Role of Tides in orbital migration - Tidal interaction of planet-star and planet-satellite	**5**
3.	**Physics of Planetary Interior**	(a) Interior of Terrestrial Planets - Lesson, we learned from our own planet - Equation of state, thermal evolution (b) Interiors of Giant Planets - High pressure physics, hydrogen phase transition (c) Can we extrapolate interior physics of solar system planets to other exoplanets?	**12**
4.	**Structure of Planetary**	(a) Lower Atmosphere	**6**

	Atmosphere and composition	- Circulation models, chemical equilibrium/disequilibrium	
5.	**Interaction of Host star with Planets**	(a) Effect of radiation in driving planetary upper atmosphere (b) Origin of solar/stellar wind and their effect on planets (c) Long-term evolution of planet and its atmosphere.	**9**
		Total number of lectures:	**40**

C) Pre-requisites: Basic physics courses e.g., classical mechanics, electrodynamics, quantum mechanics and thermodynamics

4. Recommended books:
   Planetary astrophysics by Francesco Marzari, Cambridge Scholars Publishing