PHY 458 2.0 / 497 2.0 – Space & Atmospheric Physics

Lecturer in Charge **:** Dr. M. M. P. Madhuranga Fernando

Objectives of the Course Unit:

This unit attempts to enhance the knowledge of students with the Space Physics.

Field of Study

This course is an introduction to the fields of Solar and Space Physics; it addresses the physics of plasmas in our solar system, emphasizing both observations and theory in a unified fashion. The domain of Space Physics is from Earth's upper atmosphere to the solar photosphere to the outer boundaries of our solar system where the solar wind encounters the local interstellar medium. Space Physics is sometimes defined as "astrophysics of our solar system", overlapping with solar physics in the study of the Sun.

This course should be of particular interest to people wanting to learn more about our solar system and near-Earth space environment, astrophysics, plasma physics, atmospheric physics, and solar-terrestrial interactions.

Philosophy and Motivations

Space physics and solar physics are active research fields. As such there are many phenomena which remain unexplained and theoretical problems which remain unsolved. Some of these will be described and/or posed to you.

Method of Assessment **:**

Continuous Assessments	- 40%
End of the Semester Theory Examination	- 60%
Total	- 100%

References:

* Space Physics and Space Astronomy – Michael D. Papagiannis

* Space Physics - May-Britt Kallenrode

* Radio Emission of the Sun and Planets – V. V. Zheleznyakov

* Horizons - Exploring the Universe – Michael A. Seeds

* Introduction to Astronomy – Cecilia Payne - Gaposchkin

* Foundations of Astronomy – W. M. Smart

* Answer Book of Astronomy – Iain Nicolson

* Sun, Solar Cycle, Ionosphere, Absorption cross section, Maxwell's equations, Atmospheric dispersion modeling, Wave plate – Wikipedia (Internet)

* Solar Radiation - Encyclopedia of Earth (Internet)

* Ultraviolet - Wikipedia (Internet)

* Sunspot Numbers - IPS - Solar Conditions (Monthly Sunspot Numbers) (Internet)

* Solar Physics – NASA - Marshall Solar Physics (Internet)

* Interplanetary Ionization by Solar Extreme Ultraviolet Radiation, Hinteregger, H. E., Astrophysical Journal, vol. 132, p.801

* Ionospheric Physics of Radio Wave Propagation - Edwin C. Jones (Internet)

Syllabus :

- Planetary Atmospheres
  - ★ Formation and Evolution of Planetary Atmospheres
  - ★ The Structure of the Terrestrial Atmosphere
  - ★ The Temperature of the Neutral Atmosphere
  - ★ The Escape of the Atmospheric Gases
  - ★ The Atmospheres of the Planets

- Earth's Atmospheres
  - ★ Retaining of Gases in the Earth
  - ★ Major / Minor constituents
  - ★ Barometric Equation
  - ★ Scale Height
  - ★ Atmospheric Regions
  - ★ Temperature Profiles
  - ★ Retaining of Gases
  - ★ Number Density Profiles

- The Ionosphere
  - ★ Introduction
  - ★ The Chapman Layer Theory
  - ★ Plasma Frequency
  - ★ Collision Frequency and Absorption
  - ★ The Structure of the Ionosphere and the Plasmasphere
  - ★ Regular and Irregular Variations of the Ionosphere

- The Magnetosphere
  - ★ The Earth's Magnetic Fields
  - ★ The Dipole Magnetic Field
  - ★ Motion of charged particles in a Dipole Magnetic Field
  - ★ The Radiation Belts
  - ★ The boundary and the tail of the Magnetosphere

- The Active Sun
  - ★ The Sun and Stars
  - ★ Introduction of the Active Sun
  - ★ The Photosphere
  - ★ The Chromosphere and the Corona
  - ★ Sunspots and the Solar Cycle
  - ★ Faculae, Flares and Prominences
  - ★ Radio and X-ray Bursts from the Sun
  - ★ The Development of an Active Region on the Sun
  - ★ Effect of the Solar Cycle
  - ★ Life Cycle of the Sun

- Solar- Terrestrial Relations
    - ★ Introduction
    - ★ Geomagnetic Storms and Ring Currents
    - ★ Galactic and Solar Cosmic Rays
    - ★ Auroras
    - ★ Ionospheric Disturbances

- Radio Wave Communication
    - ★ Reflection of Radio Waves
    - ★ Absorption of Radio Waves
    - ★ Complex Refractive Index
    - ★ Reflection Heights
    - ★ Deviating Region Absorption, Non- Deviating Region Absorption
    - ★ Ordinary/Extra Ordinary Waves
    - ★ Ionosphere – Sounding Techniques
    - ★ Pulse Reflection Methods

- The Interplanetary Space
    - ★ Introduction
    - ★ Characteristic Parameters of fully Ionized Plasmas
    - ★ Hydrodynamic Equations in the Solar Corona
    - ★ The Supersonic Flow of the Solar Wind
    - ★ The Interplanetary Magnetic Field
    - ★ Interplanetary Dust

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