PHY 458 2.0 / 497 2.0 – Space and 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 and Atmospheric Physics.

Field of Study

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

Aims and Objectives of the course unit :

The course unit aims to familiarize the students with the fundamental and advanced aspects of Space and Atmospheric Physics and develop the student's practical knowledge and skills through a series of lectures, solving problems, class room demonstrations as well as discussions.

It further aims to develop the students comprehension of modern practical knowledge of the Earth's Atmosphere, Earth's Ionosphere, Earth's Magnetosphere, The Sun and How to do Radio Wave Communications using the knowledge of Space and Atmospheric Physics.

Learning Outcomes

On completion of the course unit students will be able to,

1. Describe how to Formation and Evolution of Planetary Atmospheres in our Solar System.
2. Describe Planetary Atmospheres in our Solar System.
3. Describe in details Earth's Atmosphere with atmospheric parameters such as Pressure, Number Density, Air Density, Mean Molecular Distance, Mean Molecular Weight, Temperature Distribution and Gravity Variations.
   Also students can write source codes to implements above results mathematically and graphically.
4. Describe The Ionosphere, the Plasma-sphere and plasma frequency of the ionosphere.
5. Explain & derive an equation for the Pair Production of the ionosphere to explain the Chapman Layer Theory.
6. Describe the Earth's Magnetic Field.
7. Derive an equation for the Dipole Magnetic Field.
8. Explain the Earth's Magnetic Field using equation of the Dipole Magnetic Field.
9. Describe The Radiation Belts and how they build.
10. Describe The Active Sun.
11. Identify the regions of the Sun.
12. How to measure number of sunspots using telescopic image.
13. Describe how to do Radio Wave Communication works.
14. Describe why Refractive Index in the ionosphere explains as a Complex Number.
15. Describe Reflection and Absorption of Radio Waves.
16. Describe what is Pulse Reflection Method and important of the method to study the ionosphere.
17. Describe how to do Radio Wave Communication using the knowledge of space and atmospheric physics.
18. Explain and Identify the Expectable Crisis of Radio Wave Communication.
19. Describe in briefly about The Interplanetary Space with Plasma Physics.
20. Describe in briefly about Solar- Terrestrial Relations with Geomagnetic Parameters.

Recommended readings:

* 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)

Method of teaching/learning for the course unit

1. Lectures
2. Tutorial classes
3. Practical classes (Computational)
4. Self-studies / written assignment and presentation on the given topics
5. Discussion classes

Method of Assessment :

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