



University of Kerala

Discipline	PHYSICS				
Course Code	UK4DSEPHY203				
Course Title	SOLAR TERRESTRIAL PHYSICS				
Type of Course	DSE				
Semester	IV				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 Hrs	-	2 Hrs	5 Hrs
Pre-requisites	Knowledge about solar system, laws of motion, different heat transfer methods and electromagnetism.				
Course Summary	This course aims to impart basic knowledge on the characteristics and composition of the Sun, Earth, solar activity and Earth's upper atmosphere via geomagnetism. After completing the course, the student gets a thorough understanding of the fundamental characteristics of the sun, earth, and solar-terrestrial interaction phenomena.				

BOOKS FOR STUDY:

1. Hand book of the Solar-Terrestrial Environment, Yohsuke Kamide AbrahamC.-L.Chian (Eds.)
2. Physics of the Space Environment, Gombosi, T. I., Cambridge University Press, 1998
3. Solar activity and earth's climate, Rasmus E Benestad, Springer
4. Earth's Proximal Space- ChanchalUberoi (2000), Universities Press (India)
5. The Sun, the Earth, and Near-Earth Space,John A Eddy,NASA
6. The Solar Terrestrial Environment, J. K. Hargreaves, Cambridge Atmospheric and space science
7. Physics of the Earth's Space Environment,Gerd W. Prolls,Springer

BOOKS FOR REFERENCE:

1. Introduction to Space Physics, M. G. Kivelson and C. T. Russel, Cambridge University Press
2. Fundamentals of solar astronomy by Arvind Bhatnagar, William Livingston (World Scientific Series in Astronomy Astrophysics, Vol-6)
3. A Beginner's Guide to Working with Astronomical Data, Markus Possel (1905.13189v2.pdf (arxiv.org))

WEB RESOURCES-THEORY

1. <https://www.swpc.noaa.gov/phenomena/earths-magnetosphere>
2. https://solarscience.msfc.nasa.gov/the_key.shtml
3. http://jsoc.stanford.edu/~jsoc/keywords/Chris_Russel/Geophysical%20Coordinate%20Transformations.htm

WEB RESOURCES-PRACTICAL

1. <https://va-iitk.vlabs.ac.in/?page=exp13>
2. <https://va-iitk.vlabs.ac.in/?page=exp5>
3. https://www.researchgate.net/publication/324106257_Apparent_and_Absolute_Magnitudes_of_Stars_A_Simple_Formula

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I	The Sun (Book 2: chapter 11, Book 3: Chapter 3)		08	
	1	The Sun: Physical properties, Internal structure, Solar atmosphere,	4	1
	2	Source of solar energy- thermonuclear reactions	2	1
	3	solar disk and sunspots, magnetic field, solar rotation and the solar cycle	2	1
II	Solar Activity (Book 1: Chapter 5, Book 3: Chapter 4, Book 5: Chapter 3)		10	
		Solar magnetic field, Generation of solar magnetic field	3	2
		Solar wind, Origin of solar wind, Characteristics of solar wind	3	2
		Solar storm, Coronal mass ejections, Solar flare, solar prominence, solar energetic particle events	4	2

III	Terrestrial Atmosphere (Book 5: Chapter 4)		07	
	1	Physical properties of earth	2	3
	2	Layers of earth's atmosphere and its composition and temperature distribution	3	3
	3	The pressure profile,	1	3
	4	Scale height, Density variation	1	3
IV	Terrestrial Magnetism (Book 2: Chapter 14, Book 4: Chapter 4, Book 6: Chapter 5, Book : 7 Chapter 5)		11	
	1	Introduction to Earth's magnetic Field, Origin and elements of earth's magnetic field	1	4
	2	Geographic and geomagnetic coordinates,	2	4
	3	Earth's variable magnetic field	2	4
	4	Solar activity and Earth's magnetic weather,	2	4
	5	Solar wind interaction, structure of the magnetosphere: Magneto tail and Plasma sheet, Plasma sphere.	4	4
V*	Terrestrial upper atmosphere (Book 1: Chapter 8, Book 7: Chapter 3 & 4)		09	
	1	The Ionosphere: production of Different layers- derivation, , Ionisation profile,	4	3
	2	Effect on scale height, Ionospheric electric fields. Ionospheric hydrogen and Helium	5	3

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		CO No
Sl No	Name of Experiment	
1	To determine solar constant using principle of calorimetry	5
2	Using dry bulb – wet bulb psychrometer method calculate the relative humidity under different conditions	5

3	To study the Fraunhofer lines of the solar spectrum	5
4	To download the catalog of AGN host galaxies (Galaxy Zoo survey, catalog name: J/ApJ/711/284/table3) directly from VizieR using TOPCAT and to save the loaded catalog in CSV format.	5
5	(i) To download the GALEX images (FUV and NUV) of the Sombrero galaxy from the archive (GALEX MAST) and display the galaxy image in DS9 software. (ii) To overlay RA, Dec coordinate grid on the images and give appropriate contrast levels for the image. (iii) To export the image of the galaxy in JPEG format.	5
6	Analysis of the spectra of stars	5
7	To estimate the relative magnitude of a group of stars	5
8	Determination of Bh using deflection and vibration magneto meters.	5
9	To analyze cosmic ray intensity data from cosmic ray stations and compare the variations with the 11-year solar activity cycle.	5
10	Measurement and analysis of Sunshine duration and solar radiation using pyrheliometer	5
Part B* – At least One Experiment to be performed		
11	To determine the distance and age of cluster using Colour Magnitude Diagram	5
12	To study the effective temperature of stars by B-V photometry.	5
13	Measurement of distance to moon by parallax method	5
14	To load the AGN host galaxy catalog in TOPCAT and plot (i) Histogram of stellar mass of the galaxies (Mstar) (ii) Histogram of color (u-r color) and save the plots.	5
15	To overlay the GAIA catalog on the NUV images of the Sombrero galaxy using the catalog feature in DS9 and thus identify the stars in the GALEX image.	5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Describe the structure and nuclear reactions of the sun	U	1,3
CO-2	Explain different solar activities like solar storm, solar flare etc.	U	3
CO-3	Describe about Earth's atmosphere	U	3
CO-4	Describe Earth's magnetosphere and sun earth interactions	U	3
CO-5	Apply and analyse the concepts of astronomy and space science	U, Ap, An	2,3,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: SOLAR TERRESTRIAL PHYSICS

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Describe the structure and nuclear reactions of the sun	PO 1/ PSO 1,3	U	F,C	L	-
CO-2	Explain different solar activities like solar storm, solar flare etc.	PS 1/ PSO 3	U	F,C	L	-
CO-3	Describe about Earth's atmosphere	PS 1/ PSO 3	U	F,C	L	-
CO-4	Describe Earth's magnetosphere and sun earth interactions	PS 1/ PSO 3	U	F,C	L	-

CO-5	Apply and analyse the concepts of astronomy and space science	PO 1,2,7/ PSO 2,3,7	U, Ap, An	C, P	-	P
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F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	2	-	2	-	-	-	-	2	-	-	-	-	-	-	-
CO-2	-	-	2	-	-	-		2	-	-	-	-	-	-	-
CO-3	-	-	2	-	-	-		2	-	-	-	-	-	-	-
CO-4	-	-	2	-	-	-		2	-	-	-	-	-	-	-
CO-5	-	1	1		-	-	1	1	1	-	-	-	-	1	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	✓	-	✓
CO-2	✓	✓	-	✓
CO-3	✓	-	-	✓
CO-4	✓	-	-	✓
CO-5	✓	-	-	-