

Module Code: Phys-M3162;	EtCTS of Course: 5 ;	Course Status:	Elective
Course Title :	Space Physics		
Course Code:	Phys3163 ;	Credits Hours:	3
Mode of delivery:	Conditional;	Weeks required:	
Prerequisite(s):		Co-requisite(s):	
Academic Year:	20____/____ ;	Year/Semester:	III/
Students' College/Faculty:	_____;	Department:	Physics
Program:	Undergraduate	Enrollment:	_____
Instructor's Name (Coordinator)	_____		
Address: Email: _____	Block No. _____;	Rm. No. _____	
Class Hours:	_____		

Course Rationale

The rationale of this course are to introduce students to the basic ideas of Modern physics with emphasis on the theory of special relativity, identification of the limitations of classical mechanics and the development of quantum mechanics, the wave particle duality and the atomic structure.

Course Description

Introduction, The sun, The solar wind and the interplanetary magnetic field, The earth's magnetic field, The ionosphere, Currents in the ionosphere, The magnetosphere, The aurora, Precipitation patterns of the auroral particles.

Course Outcomes

At the end of this course students will be able to

- elaborate the solar system and its components
- define what space (universe) is and elaborate its main components
- explain the sun, solar wind and its origin
- verify the Physics of planetary magnetospheres

Course Outline: EtCTS(5)

No	Topic	Lecture (hrs)	Tutor (hrs)	Home (hrs)	T.Load (hrs)
1)	Introduction	5	1	5	11
2)	Physics of Solar System Plasmas	12	4	12	28
3)	Physics of the solar corona and the solar wind	6	2	11	19
4)	Physics of the Heliosphere	5	2	10	17
5)	Physics of the Earth's Ionosphere	5	2	10	17
6)	Physics of planetary magnetospheres	7	2	11	20
7)	Solar-Terrestrial Physics and Space Weather	5	2	11	18
	Total	45	15	70	130

Method of Teaching

Lecture, discussion, homework, tutorial and project. Online learning resources are also employed.

Tentative Time Breakdown of Lecture Topics

Date	Topics	Pedagogical Approaches	Teachers' Tasks/Activities	Students' Tasks/Activities
Week 1	Introduction <ul style="list-style-type: none"> • What is space physics • The sun and the solar corona • The solar wind 	Gapped Lecture, Group discussion, Active learning methods	Lecturing, Leading discussions, Asking and answering questions, Preparing home works, reading assignments and feedback	Listen to a lesson, take short notes, asking and answering questions, Doing home work and reading assignments, Presentation
Week 2	<ul style="list-style-type: none"> • The heliosphere • The Earth's ionosphere, planetary magnetospheres 			
Week 3	Physics of Solar System Plasmas <ul style="list-style-type: none"> • Origins; quasi-neutrality • Motion of charged particles in electric and magnetic fields • Drift motion 	Gapped Lecture, Group discussion, Active learning methods	Lecturing, Leading discussions, Asking and answering questions, Preparing home works, reading assignments and feedback	Listen to a lesson, take short notes, asking and answering questions, Doing home work and reading assignments, Presentation
Week 4	<ul style="list-style-type: none"> • Plasma as an ion-electron gas • Equations of conservation of mass, momentum and energy • The fluid description of a plasma 			
Week 5	<ul style="list-style-type: none"> • Maxwell's equations applied to a plasma • Electromagnetic force on a plasma • Magnetic tension and pressure 	Gapped Lecture, Group discussion, Active learning methods	Lecturing, Leading discussions, Asking and answering questions, Preparing home works, reading assignments and feedback	Listen to a lesson, take short notes, asking and answering questions, Doing home work and reading assignments, Presentation
Week 6	<ul style="list-style-type: none"> • The magneto hydrodynamic (MHD) approximation and frozen-in flows; MHD wave modes • Shock waves 			
Assignment I				
Week 7	Physics of the solar corona and the solar wind <ul style="list-style-type: none"> • Atmospheres in hydrostatic equilibrium • Plasma and magnetic structures in the solar corona 	Gapped Lecture, Group discussion, Active learning methods	Lecturing, Leading discussions, Asking and answering questions, Preparing home works, reading assignments and feedback	Listen to a lesson, take short notes, asking and answering questions, Doing home work and reading assignments, Presentation

Date	Topics	Pedagogical Approaches	Teachers' Tasks/Activities	Students' Tasks/Activities
Week 8	<ul style="list-style-type: none"> The origin of the solar wind and Parkers isothermal solar wind solution The solar cycle dependence of solar phenomena 	Gapped Lecture, Group discussion, Active learning methods	Lecturing, Leading discussions, Asking and answering questions, Preparing home works, reading assignments and feedback	Listen to a lesson, take short notes, asking and answering questions, Doing home work and reading assignments, Presentation
Test I				
Week 9	Physics of the Heliosphere <ul style="list-style-type: none"> The solar wind and the heliospheric magnetic field Fast and slow solar wind streams Co-rotating and transient disturbances in the solar wind; solar cycle effects 	Gapped Lecture, Group discussion, Active learning methods	Lecturing, Leading discussions, Asking and answering questions, Preparing home works, reading assignments and feedback	Listen to a lesson, take short notes, asking and answering questions, Doing home work and reading assignments, Presentation
Week 10	<ul style="list-style-type: none"> The boundary of the heliosphere and the Local Interstellar Medium Assignment II Physics of the Earths Ionosphere <ul style="list-style-type: none"> Formation of the ionosphere; photo-ionization and the Chapman production function 	Gapped Lecture, Group discussion, Active learning methods	Lecturing, Leading discussions, Asking and answering questions, Preparing home works, reading assignments and feedback	Listen to a lesson, take short notes, asking and answering questions, Doing home work and reading assignments, Presentation
Week 11	<ul style="list-style-type: none"> Ionization by energetic particles; loss mechanisms Conductivity and current systems; Ionosondes 			
Test II				
Week 12	Physics of planetary magnetospheres <ul style="list-style-type: none"> The Chapman-Ferraro problem; the interaction of the solar wind with the magnetosphere Bow shock Magnetosheath Magnetopause 	Gapped Lecture, Group discussion, Active learning methods	Lecturing, Leading discussions, Asking and answering questions, Preparing home works, reading assignments and feedback	Listen to a lesson, take short notes, asking and answering questions, Doing home work and reading assignments, Presentation

Date	Topics	Pedagogical Approaches	Teachers' Tasks/Activities	Students' Tasks/Activities
Week 13	<ul style="list-style-type: none"> • Magnetosphere • Magnetospheric tail • Plasma flows due to corotation and solar-wind driven convection • Radiation belts 	Gapped Lecture, Group discussion, Active learning methods	Lecturing, Leading discussions, Asking and answering questions, Preparing home works, reading assignments and feedback	Listen to a lesson, take short notes, asking and answering questions, Doing home work and reading assignments, Presentation
Week 14	Solar-Terrestrial Physics and Space Weather <ul style="list-style-type: none"> • Geophysical effects of solar phenomena • some practical effects of Space Weather phenomena 	Gapped Lecture, Group discussion, Active learning methods	Lecturing, Leading discussions, Asking and answering questions, Preparing home works, reading assignments and feedback	Listen to a lesson, take short notes, asking and answering questions, Doing home work and reading assignments, Presentation
Week 15	<ul style="list-style-type: none"> • solar cycle dependence of geophysical effects • problems with forecasting Space Weather 			
Final Exam				

Assessment

No	Type of Assessment	Time	Weight
1	Test I Test II	Week 8 Week 11	10% 10%
2	Assignment I Assignment II	Week 6 Week 10	10% 10%
3	Class activity and home work	All weeks	10%
4	Final exam	Final week	50%
		Total	100%

References

1. Basic Space Plasma Physics, W. Baumjohann and R. Treumann, Imperial College Press, 1997
2. Introduction to Space Physics, M. G. Kivelson and C. T. Russell, Cambridge University Press, 1995.
3. Physics of Solar System Plasmas, T. E. Cravens, Cambridge University Press, 1997
4. Physics of the Space Environment, T. I. Gombosi, Cambridge University Press, 1998.