



University of Science and Technology of Hanoi  
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## COURSE SYLLABUS

**Subject: Instrumentation in Ground and Space Astrophysics**

**Academic field: Astronomy**

**Lecturer: Dr. Pham Ngoc Diep**

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**Academic year: 2013-2014**

### COURSE DESCRIPTION

<b>Credit points</b>	2	
<b>Level</b>	Undergraduate	
<b>Teaching time Location</b>	University of Science and Technology of Hanoi	
<b>Time Commitment</b>	Lecture	16 hrs
	Exercises	8 hrs
	Practicals	6 hrs
	Total	30 hrs
<b>Prerequisites</b>	elementary of waves, classical mechanics, quantum mechanics, nuclear physics and particle physics	
<b>Recommended background knowledge</b>	Knowledge from Prof. Quynh Lan's lectures	
<b>Subject description:</b>	<p>This course involves an elementary introduction to astrophysics, cosmology and instrumentation in ground and space astrophysics. The logic is that students should know about the basics of astrophysics and cosmology, the major unanswered questions in the fields. Therefore, they will understand why, what and how we measure astrophysical quantities. Emphases are on understanding the principles of detecting electromagnetic waves at different wavelengths and some different particles. It is an exploratory, first course in instrumentation designed primarily for students planning to enrol in the regular-program astrophysics or related field such as space and application courses upon completion of this course. However, it also meets the needs of many students with other interests. Each UNIT is planned to be discussed in 2 hours. With practical work and/or visit to astrophysics labs, students will see in reality how a telescope works, they will have chance to operate it, take data and make some simple data analysis.</p>	
<b>Objectives &amp; Out-come</b>	<p>By the end of this course, students will be able to</p> <ol style="list-style-type: none"> <li>(1) have some very basics on astrophysics and cosmology</li> <li>(2) understand the principle of operation of basic equipments in</li> </ol>	



	astrophysics (3) have a general view on many types of instrumentation used in astrophysics (4) understand why, what and how to measure different radiation in the electromagnetic spectrum (5) have chance to see and practice with some actual astronomical equipments	
<b>Assessment/ Evaluation</b>	Attendance/Attitude	10 %
	Exercise(s)	10 %
	Practicals	10 %
	Mid-term test	20 %
	Final exam	50 %
<b>Prescribed Textbook(s)</b>	[1] Cosmology and Astrophysics: an elementary introduction, Pierre Darrilat, Ha Noi, 2004. Available online at: <a href="http://www.inst.gov.vn/Vatly/files/lecture1_astrophysics.pdf">http://www.inst.gov.vn/Vatly/files/lecture1_astrophysics.pdf</a>	

## COURSE CONTENTS & SCHEDULE

Class	Contents	Hours			Ref./Resources	Assignment(s)
		Lect.	Exr.	Prc.		
1	<p>UNIT 1: Introduction to cosmology</p> <p>The purpose of this unit is to give to students a brief history of the universe with the main events in its timeline: nuclear synthesis, recombination (CMB), formation of first galaxies and stars; the expansion and the fate of the universe; The content of the universe.</p> <p>Our universe contains about 5% ordinary matter, 23% dark matter and 72% dark energy (we know very little about our universe, most of the content of the universe is “dark”!). After this lecture, students should know what the universe consists of; what dark matter and dark energy are; how we know about the existence of these components and how we estimate the contribution of them.</p>	X				
2	<p>UNIT 2: Violent events in the universe, accretion</p> <p>Other phenomena in the universe which will be discussed are Active Galactic Nuclei (AGN),</p>	X				



	quasars, Seyfert galaxies, BL Lac and blazars and Gamma Ray Bursts (GRB). This is in complementary to Prof. Quynh Lan's lectures. Her lectures supposed to talk about other non-violent events in the universe.					
3	UNIT 3: Major unanswered questions in astrophysics	X				
4	UNIT 4: Exercises on basics astronomy		X			
5	UNIT 5: Exercises on basics astronomy		X			
6	UNIT 6: Mid-term exam					
7	UNIT 7: Generality on instrumentation in astrophysics Basics on resolution, sensitivity, ... The students will understand why we need many types of instrumentation? What do we need: why larger and larger, more and more complicated instruments have been being built.	X				
8	UNIT 8: Main components of an detection system Students will learn about the main components of a typical measurement system and the role of each component. They will also learn about the principle of the measurement.	X				
9	UNIT 9: Radio, microwaves Features of the radiation and related instruments (Very Large Array, The Jodrell Bank antenna, Green Bank radio telescope, Very Long Baseline Array, The Arecibo antenna, WMAP) will be presented.	X				
10	UNIT 10: Visible, Infrared, Ultraviolet, Xrays Features of the radiation and related instruments (The Hubble Space Telescope, SWIFT, Very Large Telescope, Ultraviolet Imaging Telescope, CHANDRA, XMM NEWTON) will be presented.	X				
11	UNIT 11: Gamma rays and Cosmic rays A bit of history of cosmic rays, detection techniques and future projects will be discussed. A typical gamma ray system (HESS) will be presented. Detection method and main components will be emphasized.	X				
12	UNIT 12: Exercises on instrumentation in astronomy		X			
13	UNIT 13: Exercises on instrumentation in astronomy		X			
14	UNIT 14: Review the course; Questions and Answer; Discussions and Exercises.			X		
15	UNIT 15: Visit VATLY (Vietnam Auger Training Laboratory) with a radio telescope			X		



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*Notes:*

- *Abbreviation: Lect. (lecture), Exr. (Exercise), Prc. (Practise).*
- *Exercises may include assignment, reports, student's presentation, homework, class exercises ...for each class sessions*
- *Practicals mostly refer to Lab- work or outside practice such as field trip.*

**Reference Literature:**

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| [1]. Cosmology and Astrophysics: an elementary introduction, Pierre Darriulat<br><a href="http://www.inst.gov.vn/Vatly/files/lecture1_astrophysics.pdf">http://www.inst.gov.vn/Vatly/files/lecture1_astrophysics.pdf</a> |
| [2]. Instrumentation in Ground and Space Astrophysics, Pierre Darriulat<br><a href="http://www.inst.gov.vn/Vatly/presentations.htm">http://www.inst.gov.vn/Vatly/presentations.htm</a>                                   |
| [3]. Radio Astronomy (2 <sup>nd</sup> edition), John D. Kraus, University of New Hampshire Printing Services, 2005.  |