Subject Description Form

Subject Code	AMA1D07
Subject Title	Introduction to Cosmology
Credit Value	3
Level	1
Pre-requisite / Co-requisite/ Exclusion	Nil
Objectives	The main objectives of this subject are: a) To offer students a general understanding, at an elementary level, of cosmology from the observational and theoretical perspectives. b) To widen student's view on forefront knowledge and enhance their independent learning skills. c) To present the basic observational facts on which our understanding of the structure and evolution of the Universe is based d) To develop students' moral affection through raising their awareness on the roles of human beings in the nature and the universe.
Intended Learning Outcomes	a) Upon completion of the subject, students will be able to:understand the principles and laws that describe the observational/ experimental aspects of cosmology b) understand the dynamic interactive processes that take place in the Universe c) acquire the basic techniques to enhance the understanding on cosmology and science d) analyze data and make appropriate judgments on scientific phenomena e) conduct self-learning and contribute to team work in any disciplines/areas
Subject Synopsis/ Indicative Syllabus	• The visible universe. Galaxies, their structure and classification; determination of the cosmic distances; determination of the ages of the cosmic objects. • The observational basis of cosmology. The cosmological redshift; Hubble's law • Elementary theory of the Big Bang. Newtonian cosmology; the energy conservation equation; the expansion equation; cosmological models; the deceleration parameter; the age of the Universe • Elementary general relativity; the metric of the Universe; geometry of the Universe

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- Physics of the early Universe. Primordial nucleosynthesis; structure formation; the Cosmic Microwave Background; anisotropy of the Cosmic Microwave Background; the WMAP and Planck satellite observations
- The very early Universe. Problems of the standard cosmological models; inflationary models; quantum cosmology; the no-boundary proposal of Stephen Hawking
- The accelerating Universe. Supernovae as standard candles; the discovery of the recent acceleration of the Universe; dark energy and dark matter; the cosmological constant problem.

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<tr><td>Teaching/Learning Methodology</td><td>

<u>Lecture:</u>

This class will consist of 9 weekly 3-hour lectures and 4 sessions of student presentations. Each lecture will be dedicated to a particular topic relevant to the study of Cosmology. Both the mathematical and the physical aspects of the field will be stressed. We will explain the mathematics in layman's terms so as to accommodate students from different backgrounds. During the course of a lecture, pictures and videos will be presented to aid the students in obtaining an intuitive understanding. Weekly readings from classical and forefront popular science books will be assigned so that all students will have the opportunity to learn from the precise yet non-technical writing styles of cosmology scholars.

<u>Observations:</u>

We will offer three observation sessions for a total of 8 hours. The Objects that will be observed include the sun, stars, and other celestial bodies. The observations will be done using optical and radio telescopes. In each session, each student will complete a set of experimental exercises for evaluation. After each observation session, students are required to complete a laboratory report in analyzing real time data.

Visiting Hong Kong Astronomical Observatory (Ho Koon)

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<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes</td><td>

<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="5">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td></tr>
<tr><td>1. Assignment</td><td>20%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>2. Observation exercises</td><td>20%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>3. Test</td><td>30%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>4. Presentation</td><td>30%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Total</td><td>100 %</td><td colspan="5"></td></tr>
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	Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes: There will be three observational work sheets, one take-home assignment, one mid-term test, and one final presentation. We guarantee that the observation equipments are enough to accommodate the needs for all the students. For instance, we have solar filters that every student can use for doing observation of the sun. <u>Final presentation;</u> At the end of the semester, students will divide into groups. Each group will deliver a presentation on an assigned topic related to cosmology. Through these presentations, students will have the opportunity to acquire the skills of self-learning, analysis and organization of material, critical thinking, teamwork, and communication, all of which are important skills that our university graduate should possess. Topics of presentation We will suggest some interesting topics to the students for doing project presentation. The topics are suggested as follows: Black Holes, Dark Matter, Dark Energy, 21cm Cosmology, String Cosmology, Gravitational Wave Cosmology, Large Scale Structure, Supernovae Cosmology, Brain-World Cosmology, Parallel Universe, etc.	
Student Study Effort Expected	Lecture and presentation	39 Hrs
	Observations	8 Hrs
	Other student study effort:	60 Hrs
	Total student study effort	107 Hrs
Reading List and References	An Introduction to Galaxies and Cosmology, by Mark H. Jones and Robert J. Lambourne, Cambridge University Press, 2015 Astronomy Today Volume 2 : Stars and Galaxies (8th Edition) by Eric Chaisson and Steve McMillan, Pearson Education, Inc., Addison-Wesley, 2014 Extragalactic Astronomy and Cosmology: An Introduction, by Peter Schneider, Springer, 2014 Cosmology: A First Course, by Marc Lachieze-Rey, Cambridge University Press, 2011 An Introduction to Modern Astrophysics, by B. W. Carroll and D. A. Ostlie, Pearson, 2013	