

PHY 100: Physics for the Next Generation

Co-offered with AST 100: Our Cosmic History

Independent University, Bangladesh (<https://iub.ac.bd/>)

Course code	PHY 100 / AST 100	Course title	Our Cosmic History
Course type	General Education / Foundation	Prerequisites (if any)	
Credit value	3	Contact hours /week	3

Course Rationale

The course introduces the 14 billion of history of the universe from a human point of view. The history is divided into seven ages and the basic underlying principle governing change in all the ages is exemplified. This universal change is governed by chance and necessity and is arguably directed toward creating more complexity. The course uses theories from all branches of natural science but presents them without jargon and equations. The emphasis is on finding the place of humanity within the cosmic spacetime.

Course Content

Road to reality: nature of reality, tree of knowledge, science and scientific method; definition of time, evolution and the universe. **Cosmic evolution:** nature of light, expansion of the universe; relativity, spacetime curvature and gravity; order and disorder, energy and entropy, complexity. **Seven ages of the universe:** dividing the history of the universe into seven chronological ages, metaphorically relating the ages with the different stages of a river. **Particle age:** chaos, fundamental particles and forces, big bang, matter from energy and back, radiation era, matter era, atoms, the first second after big bang. **Galactic age:** various types of galaxies, our neighborhood in the universe, active galaxies, supermassive black holes, formation of the first galaxies, evolution of galaxies. **Stellar age:** condensation of interstellar matter, formation of stars from gas clouds, protostars, life of a star, the sun, red giants and white dwarves, cooking of chemical elements, death of a star, supernova, black holes and neutron stars. **Planetary age:** formation of planetary systems in general; exoplanets; history of our solar system, inner rocky planets, outer gaseous planets, asteroids and comets. **Chemical age:** rise of oceans, energy and complexity, origin of life, life's chirality, living molecules from nonliving matter, measuring complexity. **Biological age:** the first living cells, photosynthesis, earth's atmosphere and the ozone layer, dating fossils, life beyond earth and astrobiology; history of life on earth, evolution as the theory behind this history; brain and consciousness. **Cultural age:** genetic and fossil records of human history, human evolution; importance of brain size; environmental change as the motor of evolution; language and consciousness; social and cultural evolution. **The Life era:** radiation era, matter era and life era; technological revolution, globalization. **Future:** possible futures of humanity, future of the universe.

Course Objectives

1. Recognize the fundamental makeup of physical reality and the ways to know that reality.
2. Outline the seven ages in the 14 billion years of history of the universe.
3. Comprehend the concepts that can explain the most important trends in this universal history.

4. Perform simple arithmetic calculations to internalize vast scales in space and time.
5. Describe how matter emerged from energy, and life emerged from matter.
6. Compare the historical timeline of the universe with the flow of a river metaphorically and realize the importance of metaphors.
7. Apply the universal concept of evolution at different scales.
8. Ask ‘where do we come from, what are we, and where are we going?’

Course Learning Outcomes (CLOs) with mapping to PLOs

CLOs	CLO Statement	Corresponding PLO(s)
CLO1	Understand our place and time in the vastness of space and history of the universe.	PLO1: Knowledge
CLO2	Identify and analyze the methods scientists use to uncover the history of humanity and the universe.	PLO1: Knowledge
CLO3	Explain the relevance of the cosmic history in one’s professional and cultural life through personal essays.	PLO9: Lifelong learning
CLO4	Realize the importance of learning from the universe throughout one’s life and using the learning to change society.	PLO5: Ethics and Society

Teaching-Learning-Assessment Strategies with mapping to CLOs

Week	Topic	Teaching-Learning Strategy	Assessment Strategy	Corresponding CLOs
1	Road to reality	Lecture, Discussion	Quiz, Essay	CLO1, CLO2, CLO3
2	Cosmic evolution	Lecture, Discussion	Quiz, Essay	CLO1, CLO2, CLO3
3	Seven ages of the universe Quiz 1	Lecture, Discussion	Quiz, Essay	CLO1, CLO2, CLO3
4	Particle age	Lecture, Discussion	Quiz, Essay	CLO1, CLO2, CLO3
5	Galactic age	Lecture, Discussion	Quiz, Essay	CLO1, CLO2, CLO3
6	Stellar age	Lecture, Discussion	Essay	CLO3
7	Review of weeks 1–6 Quiz 2	Lecture, Discussion	Essay	CLO3
8	Planetary age	Lecture, Discussion	Quiz, Project	CLO1, CLO2, CLO4
9	Chemical age	Lecture, Discussion	Quiz, Project	CLO1, CLO2, CLO4

10	Biological age Quiz 3	Lecture, Discussion	Quiz, Project	CLO1, CLO2, CLO4
11	Cultural age	Lecture, Discussion	Quiz, Project	CLO1, CLO2, CLO4
12	The Life Era	Lecture, Discussion	Quiz, Project	CLO1, CLO2, CLO4
13	Future Quiz 4	Lecture, Discussion	Project	CLO4
14	Review of weeks 8–13	Lecture, Discussion	Project	CLO4

Assessment and Evaluation

Assessment method	Assessment tools	Marks	Subtotal	Total
Continuous assessment	Class performance	15%	50%	100%
	Quizzes	35%		
Summative assessment	Midterm Essay	20%	50%	
	Final Project	30%		

Textbooks

1. Eric Chaisson, *Epic of Evolution: Seven Ages of the Cosmos*, Columbia University Press, 2005.
2. David Christian, *Maps of Time: An Introduction to Big History*, University of California Press, 2011.
3. Fred Spier, *Big History and the Future of Humanity*, Wiley Blackwell, 2015.

Instructor

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