

Natural Science (PHYS-1135)

DESCRIPTION

The course provides an interdisciplinary overview of the core natural-science disciplines: Physics, Astronomy, Chemistry, Biology and Geosciences, along with their everyday applications. Students explore fundamental concepts, scientific reasoning, and how science shapes daily life, technology, and the environment.

COURSE LEARNING OUTCOMES

By the end of this course, students will be able to:

1. Explain key principles from physics, astronomy, chemistry, biology, and geosciences.
2. Apply scientific methods to everyday observations.
3. Recognize the interdisciplinary nature of real-world problems.
4. Demonstrate basic laboratory and analytical skills.

SYLLABUS

1. Introduction to Natural Sciences

- Definition and scope of natural sciences
- Scientific methods (observations, hypothesis, experimentation, theory formulation, and application)
- Ethics in scientific advancement

2. Physics and Astronomy

- Introduction to physics, derived quantities, units and dimensions (SI system), velocity, and acceleration

- Newton's laws of motion, linear momentum and conservation laws, circular motion and centripetal force
- Definition of work, kinetic and potential energy, conservation of energy principle
- Newton's law of universal gravitation, weight and mass
- Types and properties of waves, sound waves and their characteristics
- Nature of light, reflection and refraction (Snell's law), lenses and mirrors
- Electric charge and current, Ohm's law, circuits, magnetic field and magnetic force, Faraday's law
- Solar system, Kepler's laws of planetary motion, astronomical coordinates, motion of the moon, moon sighting, eclipses

3. Chemistry - Matter, Chemical Reactions, and Materials

- Basics, states of matter, atoms, molecules and periodic table
- Chemical reactions - endothermic and exothermic reactions, balancing simple chemical equations, properties of acids and bases
- Common materials - polymers (natural and synthetic), minerals, ceramics, nanomaterials and their applications
- Chemical safety - non-hazardous and hazardous chemicals, handling and safe disposal of chemicals, understanding common pollutants and methods to recycle or reduce them

4. Biology - Cells, Genetics, Ecology, Human Body and Health

- Hierarchical organization of life - understanding cell structure and functions, molecules of life, food and nutrition
- Genetics, hereditary and molecular basis of evolution
- Ecological concept of ecosystem - energy flow in ecosystem, biogeochemical cycles and biodiversity conservation

- Structure and functions of human organs and organ systems, common diseases and preventions (microbes, viruses, parasites, zoonoses, immunity, antibiotics and vaccines)

5. Geosciences

- Understanding of earth - internal structure of earth and types of rocks and soil
- Weather and climate - climate change, climate drivers, greenhouse effect, and air, water and noise pollution
- Introduction of remote sensing and geographical information system (GIS)
- Natural and human hazards - earthquake, flood, drought, heatwave, and smog

SUGGESTED PRACTICAL WORK

1. Measurement of physical quantities using Vernier callipers and micrometre screw gauge
2. Study of refraction through a glass slab or lens
3. Determination of acceleration due to gravity (simple pendulum)
4. Astronomical observation
5. Chemical laboratory protocols
6. Safe handling and disposal of chemicals and reagents
7. Microscopy - study of plant and animal cells
8. Biodiversity and environment - field survey of local flora/fauna, assessment of ecosystem diversity
9. Understanding of global coordinate systems and map projections

Note: Any other experiment according to the available facilities at university.

SUGGESTED INSTRUCTIONAL/READING MATERIAL

1. "Fundamentals of Physics" by D. Halliday, R. Resnick & J. Walker
2. "College Physics" by R. A. Serway, C. Vuille & J. M. Hughes
3. "Introduction to Astronomy and Cosmology" by I. Morison
4. "Chemistry: The Central Science" by B. H. Eugene, LeMay, B. E. Bursten, C. J. Murphy, P. M. Woodward, M.W. Stoltzfus
5. "General Chemistry: The Essential Concepts" by R. Chang & J. Overby
6. "Basic Concepts of Chemistry" by L. J. Mone, T. O. Dolter, & S. Gentemann
7. "Laboratory Safety for Chemistry Students" by Jr. R. H Hill & D. C. Finster
8. "Biology" by N. A. Campbell & J. B. Reece
9. "Zoology" by S. A. Miller & J. P. Harley
10. "Integrated Principles of Zoology" by C. P. Hikman, L. S. Roberts, A. Larson
11. "Lippincott Illustrated Review Biochemistry" by R. A. Harvey & D. R. Ferrier
12. "Food Science" by N. Potter & J. Hotchkiss
13. "Physical Geography" by J. Patrick & T. Radtke
14. "Introduction to Geographic Information Systems" by K. T. Chang
15. "Introduction to Environmental Sciences and Sustainability" by E. P. Harris