PHY4092 : Nuclear Physics

Programme: B.Tech. Year: 4th year Semester : Even semester
Course : Elective Course Credits : 3 Hours : 40

Course Context and Overview:

The Nuclear Physics course is intended to give the student a strong basis for understanding the smallest constituents of the universe. The properties of the atomic nucleus are discussed in terms of the forces involved, with models to explain the same. Radioactive decay and dating are discussed. The course touches upon fission and fusion as sources of nuclear energy and power. Finally particle accelerators and detectors are explained at a basic level.

Prerequisite Courses:

Classical Physics (B.Tech-1 course)

Course Outcomes:

CO1: Students will have an understanding of the fundamental constituents of nature at a microscopic level and the forces acting between them.

CO2: Students will be familiar with the basic physical mechanisms leading to the generation of nuclear power.

CO3: Students will have an overview of the widespread use of nuclear technology in today's age, including radioactive dating, nuclear reactors and nuclear weapons.

CO4: Students will have a theoretical grounding regarding the techniques of particle accelerators and detectors.

Course Topics and contact hours allotment:

Topics	Contact Hours
Overview of nuclear properties and nuclear forces: Nuclear radius, nuclear mass and binding energy, angular momentum, charge distribution, spin and parity. Nucleon-nucleon-force, deuteron, pi-meson exchange model, Yukawa hypothesis. Nuclear models – liquid drop model, single-particle shell model, validity and limitations, spin-orbit interactions, collective model, nuclear rotation and vibration.	12
Radioactive decays and nuclear reactions: General properties, radioactive dating, Alpha, Beta and Gamma decay. Nuclear reactions, conservation laws, cross-sections. Compound nuclei and direct reactions.	8

Nuclear power and reactors: Nuclear fission and fusion, nuclear power, mechanism and types of nuclear reactors, present-day reactors and their uses. Other applications of nuclear technology.	12
Particle accelerators and detectors: Linear accelerators, cyclotrons, synchrotrons, basic particle detectors. The Linear Hadron Collider as a probe for fundamental Physics.	8

Textbook references (IEEE format):

Text Books:

1. A. Beiser, S. Mahajan, S. Rai Choudhury – Concepts of Modern Physics.

2. K. Krane – Introductory Nuclear Physics

Reference Books:

1. S.S.M. Wong – Introductory Nuclear Physics.

Additional Resources (NPTEL, MIT Video Lectures, Web resources etc.):

Information of relevant videos and web resources will be given during the course.

Evaluation Methods:

Item	Weightage
Quiz + presentation	20
Mid Term	30
End Term	50