# Lecture Plan

**Name of the college: Government College of Arts, Science and Commerce, Sanquelim – Goa.**

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| **Name of Faculty:** Ms. Anushka Panjikar | **Subject:** Physics | |
| **Paper code:** PYD106 Nuclear Physics | **Program:** TY BSc | **Division: -** |
| **Academic year: 2024- 2025** | **Semester: VI** | **Total Lectures: 60** |

**Course Objectives: This course aims at providing students with a comprehensive understanding of nuclear properties, forces, decay processes, nuclear models, and energy applications, while equipping them with problem-solving skills and knowledge of radiation detection techniques.**

**Expected Course Outcome: ON COMPLETION OF THIS COURSE THE LEARNER WILL BE ABLE TO : 1. Explain different properties of nucleus and nuclear forces. 2. Distinguish between different types of radioactive decays and deduce energetics of different nuclear reactions. 3. Describe different nuclear models, discuss working of nuclear reactor, breedor reactor and advantages of nuclear energy. 4. List different methods of detecting nuclear radiation and explain.**

**Student Learning Outcome: Upon successful completion of this course, students will be able to analyze nuclear properties, forces, and decay processes, apply nuclear models to predict stability, solve problems related to radioactivity and nuclear reactions, and evaluate the applications of nuclear energy and radiation detection techniques.**

| Month | Lecture From | Lecture To | No. of lectures allotted | Topic, Subtopic to be covered | Exercise/ Assignment | ICT Tools | Reference books |
|---|---|---|---|---|---|---|---|
| December | 16-12-24 | 21-12-24 | 4 | Introduction to Nuclear Physics | Group discussion | Powerpoint presentation<br><br>Google classroom | Irving Kaplan, Nuclear Physics, Narosa Publishing House<br><br>S.B. Patel, Nuclear Physics, TMH |
| December | 23/12/24 | 31/12/24 | 0 | Christmas vacation | | | |
| | | | | | | | |
| January | 02/01/25 | 04/01/25 | 3 | 1. Nuclear Properties : Constituents of nucleus, Isotope, Isotone & Isobar | MCQ Quiz | Powerpoint presentation<br><br>Google classroom | Irving Kaplan, Nuclear Physics, Narosa Publishing House |

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| | | | | 2. Radii & Density of nucleus, Definition of a.m.u, Mass of nuclei, Mass defect, Packing fraction, Binding energy<br>3. Binding energy, Stability of nuclei | | | S.B. Patel, Nuclear Physics, TMH |
| January | 06/01/25 | 11/01/25 | 4 | 1. Magnetic dipole moments.<br>2. Electrical quadrupole moment.<br>3. Nuclear forces : Main characteristics of nuclear forces;<br>4. Deuteron problem | MCQ Quiz | Powerpoint presentation<br><br>Google classroom | Irving Kaplan, Nuclear Physics, Narosa Publishing House<br><br>S.B. Patel, Nuclear Physics, TMH |
| January | 13/01/25 | 18/01/25 | 4 | 1. Meson theory of nuclear forces, estimation of mass of meson using Heisenberg's uncertainty Principle.<br>2. Yukawa potential<br>3. Radioactivity : Law of | MCQ Quiz | Powerpoint presentation<br><br>Google classroom | Irving Kaplan, Nuclear Physics, Narosa Publishing House<br><br>S.B. Patel, Nuclear Physics, TMH |

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| | | | | radioactive decay; half & mean life<br><br>4. Problem solving | | | |
| January | 20/01/25 | 25/01/25 | 4 | 1. ISA 1 Assignmnt<br>2. Problem solving<br>3. Revision<br>4. Statistical nature of radioactive phenomenon, Successive radioactive transformation (A→B→C type) | Powerpoint presentation | Powerpoint presentation | Irving Kaplan, Nuclear Physics, Narosa Publishing House<br><br>S.B. Patel, Nuclear Physics, TMH |
| January | 27/01/25 | 31/01/25 | 3 | 1. Ideal, transient and secular equilibrium<br>2. Radioactive series<br>3. Radioactive-carbon dating, Applications, Problems | MCQ Quiz | Powerpoint presentation<br><br>Google classroom | Irving Kaplan, Nuclear Physics, Narosa Publishing House<br><br>S.B. Patel, Nuclear Physics, TMH |
| February | 01/02/25 | 08/02/25 | 5 | 1. Nuclear Reactions : Artificial transmutation, Definition, Compound nucleus, | MCQ Quiz | Powerpoint presentation<br><br>Google classroom | Irving Kaplan, Nuclear Physics, Narosa Publishing House<br><br>S.B. Patel, Nuclear Physics, TMH |

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| | | | | 2. Types of nuclear reactions Conservation laws,<br>3. Energetics of nuclear reactions, Q value<br>4. Threshold energy of endoergic reactions<br>5. cross sections of nuclear reactions | | | |
| February | 10/02/25 | 15/02/25 | 4 | 1. Discovery of neutron, Determination of neutron mass<br>2. Problem solving<br>3. Doubt clearing session<br>4. Radioactive Decay Alpha decay: Velocity and energy of alpha particles; Alpha disintegration energy | MCQ Quiz | Powerpoint presentation<br><br>Google classroom | Irving Kaplan, Nuclear Physics, Narosa Publishing House<br><br>S.B. Patel, Nuclear Physics, TMH |
| February | 17/02/25 | 22/02/25 | 4 | 1. Geiger-Nuttal law, alpha spectra and fine structure<br>2. Short range and long range alpha particles; Gamow theory of | MCQ Quiz | Powerpoint presentation<br><br>Google classroom | Irving Kaplan, Nuclear Physics, Narosa Publishing House<br><br>S.B. Patel, Nuclear Physics, TMH |

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| | | | | alpha decay (qualitative treatment)<br>3. Beta decay: Types of beta decay<br>4. Energies of beta decay; the continuous beta particle spectrum | | | |
| February | 24/02/25 | 28/02/25 | 3 | 1. Difficulties in understanding the spectrum; Pauli's neutrino hypothesis<br>2. Fermi's theory of beta decay (qualitative treatment)<br>3. Gamma decay: Origin of the decay; internal conversion and nuclear isomerism | MCQ Quiz | Powerpoint presentation<br><br>Google classroom | Irving Kaplan, Nuclear Physics, Narosa Publishing House<br><br>S.B. Patel, Nuclear Physics, TMH |
| March | 01/03/25 | 08/03/25 | 5 | 1. Problem solving<br>2. Nuclear Models : Liquid drop model<br>3. Wiezsacker's semi empirical mass formula; mass parabolas; prediction of stability<br>4. spontaneous and induced fission; Bohr-Wheeler theory of nuclear fission and | MCQ Quiz | Powerpoint presentation<br><br>Google classroom | Irving Kaplan, Nuclear Physics, Narosa Publishing House<br><br>S.B. Patel, Nuclear Physics, TMH |

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| | | | | condition for spontaneous fission on the basis of Z/A<br>5. Estimation of energy released from binding energy curve and from energy – mass equivalence. | | | |
| March | 10/03/25 | 15/03/25 | 3 | 1. Nuclear Shell Model<br>2. Magic numbers; main assumptions of the single particle shell model; Jensen-Mayer scheme (no derivation)<br>3. Predictions of the shell model- Spin and Parity | MCQ Quiz | Powerpoint presentation<br><br>Google classroom | Irving Kaplan, Nuclear Physics, Narosa Publishing House<br><br>S.B. Patel, Nuclear Physics, TMH |
| March | 17/03/25 | 22/03/25 | 4 | 1. Nuclear energy: Neutron induced fission; chain reaction; mass yield in an asymmetrical fission<br>2. ISA 2 Written test<br>3. Neutron cycle in a thermal nuclear reactor (the four factor formula)<br>4. Structure of nuclear reactor and it’s | MCQ Quiz | Powerpoint presentation<br><br>Google classroom | Irving Kaplan, Nuclear Physics, Narosa Publishing House<br><br>S.B. Patel, Nuclear Physics, TMH |

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| | | | | working; principle of a breeder reactor<br>Nuclear Program in India- Nuclear Energy , Nuclear test ( Pokhran- I & II), Nuclear submarine | | | |
| March | 24/03/25 | 31/03/25 | 4 | 1. Detection of nuclear radiation: Ionization chamber<br>2. proportional chamber; Geiger Muller counter<br>3. Photographic emulsions; Semiconductor detectors<br>4. Summary, discussion | MCQ Quiz | Powerpoint presentation<br><br>Google classroom | Irving Kaplan, Nuclear Physics, Narosa Publishing House<br><br>S.B. Patel, Nuclear Physics, TMH |
| April | 01/04/25 | 05/04/25 | 4 | 1. Problem solving<br>2. Revision<br>3. Revision<br>4. Revision | Written Test | Powerpoint presentation<br><br>Google classroom | Irving Kaplan, Nuclear Physics, Narosa Publishing House<br><br>S.B. Patel, Nuclear Physics, TMH |
| April | 07/04/25 | 11/04/25 | 3 | 1. Revision<br>2. Revision<br>3. Revision | Discussion | Powerpoint presentation<br><br>Google classroom | Irving Kaplan, Nuclear Physics, Narosa Publishing House |

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***Assessment Rubrics**

| Component | Max Marks |
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| ISA 1 Assignment | 10 |
| ISA 2 Written Test | 10 |
| Semester End Exam | 80 |