Sankalchand Patel University

Faculty of Science & Humanities

Master of Science (Physics) (Sem-4)

In Effect from Academic Year 2022-23

Subject Code:1SC2050401	**Subject Title: Nuclear and Particle Physics**

COURSE OBJECTIVE:

Physics is a science to understand the nature. This course is designed to get basic understanding of the physical world.

LEARNING OUTCOMES:

- Develop an actual understanding of use of Nuclear and Particle Physics.

Teaching scheme (hours) per week		**Credit**		**University Examination**		**Internal Examination**		**Total**
Theory	**Practical**	**Theory**	**Practical**	**University Assessment**	**Practical**	**Internal Assessment**	**Practical**	
4	**--**	**4**	**--**	**60**	**-**	**40**	**---**	**100**

Unit	**Content**	**Lectures**	**Weight (%)**
1	The deuteron Problem - The ground state of deuteron shape of ground state wave function Schrodinger wave equation and its solution, Normalization of deuteron wave function, radius of deuteron, Mixing of orbitals in deuteron, Magnetic moment of Deuteron, Quadrupole moment of deuteron. Nuclear Forces – charge independence, charge symmetry, Non central (Tensor) force, Exchange forces. Single particle shell model, Explanation of nuclear data islands of isomerism, Successes and failures of shell model. Collective nuclear model, Rotational motion of the nucleus, Vibration of spherical nuclei, classification of vibration of spherical nuclei, classification of vibration of spherical nuclei	15	25
2	Alpha Decay: Basic alpha decay processes alpha decay systematic, Geiger Theory of alpha emission, Angular momentum and parity in alpha decay. Beta decay: Experimental information about Beta particles, Energy release in Beta decay(Q-Value). Continious beta Spectrum and neutrino Hypothesis, Fermi theory of beta selection rules, Experimental detection of neutrino. Gamma decay - Electromagnetic transitions, Radiation field multipolarity, selection rules, Gamma ray transistion probability.	15	25
3	Interaction of heavy charged particles with matter, energy loss by electrons, Absorption curve and range, Interaction and slowing down of neutrons in matter. Nuclear Reaction mechanism, pre-equillibrium reaction-compound nucleus reaction theory Nuclear Fusion, Sources of energy in stars, nucleo- synthesis processes, Controlled fusion, Lawson Criterion. Applications of Nuclear Physics: - Trace element analysis, Alpha decay application, Diagnostic and therapeutic nuclear medicine, Hadron therapy.	15	25
4	Classification of fundamental forces, Elementary particles and their quantum numbers, Conservationlaws, CPT theorem. Gellmann- Nishijima formula, Quark model, Baryons and mesons- their quark structure. Parity non-conservation in weak decays, Wu's experiment, Summary of Standard model of Particle physics. Introduction to field theory, Gauge theory,. Electro-Weak theory, Spontaneous symmetry breaking, Higgsboson, Grand Unification attempts and Early Universe.	15	25

Basic Reference book:

1. Introductory Nuclear Physics by Kenneth S Krane, John Wiley & Sons, Singapore(1988)
2. Fundamentals of Nuclear Physics by J. C. Verma, R. C. Bhandari& D.R.S. Somayajulu(2005) CBS Publishers & Distributers, New Delhi.
3. Fundamentals of Nuclear Physics by Jahan Singh, PragatiPrakashan, Meerut 1sted.2012.
4. Introduction to Particle Physics' by M P Khanna, Prentice Hall of India (1999) NewDelhi
5. An Introduction to Nuclear Physics' by W N Cottingam& Greenwood, Cambridge Univ.Press UK
6. Introduction to High energy Physics' by D H Perkins, Addison Wesley
7. Introduction to Elementary particles' by David Griffiths, John Wiley & Sons Singapore(1987).
8. Introduction To Nuclear And Particle Physics' by R C Verma, V K Mittal S C Gupta Prentice Hall of India (2009), New Delhi