ST.JOSEPH'S COLLEGE FOR WOMEN (AUTONOMOUS), VISAKHAPATNAM

VIII SEMESTER **PHYSICS** TIME:3Hrs/week
PH 8403 (4) **NUCLEAR AND PARTICLE PHYSICS** Max.Marks:100
w.e.f. 20AH Batch **SYLLABUS**

Course Objectives:

- *The course aims to provide a comprehensive understanding of nuclear forces and models, nuclear reactions and decays, nuclear accelerators and reactors, elementary particles, and cosmic rays.*

Course Outcomes:

Upon the successful completion of the course, students will be able to:

- *CO1: Discuss the characteristics of nuclear forces and the different nuclear models.*
- *CO2: Explain the different types of nuclear reactions, nuclear transformations through nuclear decays, interaction of gamma radiation with matter, Photoelectric effect ,Compton scattering and Pair production.*
- *CO3: Describe the functioning of nuclear accelerators, nuclear reactors and classification.*
- *CO4: Summarize the classification of elementary particles, their interactions, conservation laws, CPT theorem, symmetries, and Quark model.*
- *CO5: Discuss cosmic rays, their origin, high energy interactions, and the interpretation of geomagnetic effects.*

SYLLABUS

UNIT– I: Nuclear Forces and Models **12 Hrs**

Nuclear Forces: Characteristics of nuclear forces – Ground state of Deuteron – Proton –Proton scattering – Neutron – Proton scattering–Meson theory of nuclear forces.

Nuclear Models: Introduction–The liquid drop model – Bethe-Weizackersemi-empirical binding energy equation and its applications – Nuclear shell model – Energy levels and calculation of angular momentum– Collective model.

UNIT–II: Nuclear Reactions and Decays **14 Hrs**

Nuclear Reactions: Types of nuclear reactions – Compound nuclear reactions– Nuclear cross section–Resonance theory– Briet Wigner formula.

Nuclear Decays: Nuclear transformations – Radioactive decay – Alpha decay – Gamow's theory – Beta decay – Fermi theory – Selection rules – Interaction of gamma radiation with matter – Photoelectric effect – Compton scattering – Pair production.

UNIT–III: Nuclear Accelerators and Reactors **12Hrs**

Nuclear Accelerators: Introduction – Linear accelerators – Drift tube and Wave guide accelerators–Low energy circular accelerators – Cyclotron and Betatron – High-energy circular accelerators– Synchrotron and Microtron.

Nuclear Reactors: Nuclear fission and fusion reactions – Nuclear chain reactions – Four factor formula –The critical size of a reactor – General aspects of reactor design – Classification of reactors – Power reactors (elementary aspects only).

UNIT–IV: Elementary Particles **13 Hrs**

Discovery and classification of elementary particles–Types of interactions – Conservation laws–Iso- spin, parity, charge conjugation – Time reversal – CPT theorem – Properties of leptons, mesons and baryons – Elementary particle symmetries (SU2 and SU3 symmetries) – Quark model – Search for Higg's particle – elementary ideas.

UNIT-V: Cosmic Rays **12 Hrs**

Introduction, Secondary cosmic rays, geometric effects, Interpretation of geomagnetic effects, Absorption of cosmic rays, Showers, Cosmic ray primaries, high energy nuclear interactions, Extensive air showers, Origin of Cosmic rays.

List of Activities:

1. Assignments
2. Student Seminars

Recommended Books

1. Atomic and Nuclear Physics (Vol.2), S. N. Ghoshal, S. Chand & Co.(1994).

2. Nuclear Physics, D.C.Tayal, Himalaya Pub.(1997).

3. Atomic and Nuclear Physics ,R.C. Sharma, K. Nath & Co.,Meerut(2007).

4. Nuclei and Particles, E.Segre, WABenjamin. Inc.,(1965).

Reference Books

1. Nuclear Physics, Irving Kaplan, Narosa Pub.(1998).

2. Nuclear Physics, Theory and experiment–P.R.Roy and B.P. Nigam, New AgeInt.1997.

3. Introduction to Nuclear Physics, H. A. Enge, Addison Wesley(1975).

4. Introduction to Nuclear Physics, K.S. Krane, John Wiley &Sons(1988).