Approval: 9th Senate Meeting

Course Name	**: Nuclear and Particle Physics**
Course Number	**: PH 611**
Credits	**: 4-0-0-4**
Prerequisites	**: PH 514 Quantum Mechanics-I , PH 521Electromagnetic Theory**
Intended for	**: UG/PG**
Distribution	**: Core for I-Ph.D.; Elective for the rest**
Semester	**: Odd**

Preamble **:** The objective of the proposed course is to introduce students to the fundamental principles and concepts of nuclear and particle physics. Students will be able to know the fundamentals of the interaction of high energy particles. This course is expected to provide a working knowledge to real-life problems.

Course Outline **:** The course begins with basic nuclear phenomenology including stability. Eventually it will explore nuclear models and reactions; experimental methods: accelerators, detectors, detector systems; particle phenomenology: leptons, hadrons, quarks; elements of the quark model: spectroscopy, magnetic moments, masses.

Modules :

1. *Properties of Nuclei*: Nuclear size, Rutherford scattering, nuclear radius and charge distribution, nuclear form factor, mass and binding energy, semiempirical mass formula, angular momentum, parity and isospin, magnetic dipole moment electric quadrupole moment and nuclear shape, experimental determination. (4 Lectures)
2. *Two-body problems*: Deuteron ground state, excited states, spin dependence of nuclear forces, electromagnetic moment and magnetic dipole moment of deuteron and the necessity of tensor forces, two nucleon scattering, n-p scattering, partial wave analysis, phase-shift, scattering length, p-p scattering, charge symmetry and charge independence of nuclear forces, exchange nature of nuclear forces, Yukawa's theory. (6 Lectures)
3. *Nuclear decay*: Beta emission and electron capture, Fermi's theory of beta decay, selecti Liquid drop model, Fermi gas model, shell and collective model. (5 Lectures)
4. *Nuclear models*: Liquid drop model, Fermi gas model, shell and collective model. (5 Lectures)
5. *Nuclear Reactions*: Different types of reactions, conservation laws, energetics, isospin, reaction crosssection, resonance scattering and reactions, Breit-Wigner dispersion relation, Compound nucleus formation and break-up, Optical model, transfer reactions, nuclear fission, neutron physics, fusion reaction. (7 Lectures)
6. *Particle accelerators and detectors*: Electrostatic accelerators, cyclotron, Synchrotron and synchrosyclotron, linear accelerators, colliding beam accelerators, ionization chamber, scintillationdetectors, semiconductor detectors. (5 Lectures)
7. *Elementary particles*: Fundamental interactions, properties mesons and baryons, symmetries and conservation laws, charge-conjugation, parity and time reversal, CPT theorem, Gell-

Mann-Nishijima formula, intrinsic parity of pions, resonances, symmetry classification of elementary particles, quark model, concept of colour charge, discrete symmetries, properties of quarks and leptons, gauge symmetry in electrodynamics, particle interactions and Feynman diagrams. (8 Lectures)

Books:

Text

1. K. S. Krane, Introductory Nuclear Physics, John Wiley.

References

1. W. E. Burcham and M. Jobes, Nuclear and particle Physics, John Wiley & Sons Inc.R. R.
2. D. J. Grifths, Introduction to Elementary Particles, John Wiley & Sons Inc.
3. A. Das and T. Ferbel, Introduction to nuclear and particle physics, John Wiley.
4. M. A. Preston and R. K. Bhaduri, Structure of the nucleus, Addison-Wesley .
5. S. N. Ghoshal, Atomic and Nuclear Physics (Vol. 2).
6. Roy and B. P. Nigam, Nuclear Physics: Theory and Experiment, New Age.
7. D. Perkins, Introduction to High Energy Physics, Cambridge University Press; 4th edition (2000).