SARDAR PATEL UNIVERSITY
Programme & Subject: M.Sc (Physics)
Semester: IV
Syllabus with Effect from: June - 2014

Paper Code: PS04CPHY01	**Total Credit: 4**
Title Of Paper: Nuclear & Particle Physics	

Unit	Description in detail	Weightage (%)
I	A Resume of nuclear properties, Binding energy etc. The deuteron Problem - The ground state of deuteron - the Schrödinger wave equation and its solution, shape of ground state wave function, 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 -Mesons and nuclear forces, generalized Pauli Exclusion Principle.Single particle shell model, Explanation of nuclear data, Nordheim's rules for odd Z- odd N nuclei, 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.	25%
II	Alpha Decay: Basic alpha decay processes alpha decay systematic, Geiger-Nuttall Law for Alpha Decay, Theory of alpha emission, Angular momentum and parity in alpha decay.Beta decay: Experimental information about beta-particles, Energy released in beta decay (Q value), Continuous beta spectrum and neutrino hypothesis, Fermi theory of beta-decay, Fermi-Kurie plot, Angular momentum and parity selection rules, Experimental detection of neutrino.Gamma decay - Electromagnetic transitions, Radiation field multi-polarity, selection rules, gamma ray transition probability. Interaction of heavy charged particles with matter, energy loss by electrons, Absorption curve and range, Interaction and slowing down of neutrons in matter.	25%
III	Nuclear Reaction mechanism, pre-equilibrium reaction mechanism, – Compound Nucleus nuclear reaction theory, Direct interaction process in nuclear reactions, Coupled channel theory of inelastic scattering. Nuclear Fission mechanism, Fission rate and reactor power, general features of a nuclear reactor, Types (Classification) of nuclear reactors description of some special reactors.Nuclear Fusion, Sources of energy in stars, nucleo- synthesis processes, Controlled fusion, Lawson Criterion, Plasma confinement, ITER (introduction).Applications of Nuclear Physics - Trace element analysis, Alpha decay application, Diagnostic and therapeutic nuclear medicine, Hadron therapy.	25%
IV	Classification of fundamental forces, Elementary particles and their quantum numbers, Conservation laws, Gellmann- Nishijima formula, Quark model, Baryons and mesons- their quark structure. Parity non-conservation in weak decays, CP and CPT invariance.Gauge theory, Summary of Standard model of Particle physics. Electro-Weak theory, Spontaneous symmetry breaking, Higgs boson, Experimental verification in support of the Standard model, High energy accelerators, Proton Synchrotron &LHC, Grand Unification attempts and Early Universe.	25%

Basic Text & Reference Books:-

- Introduction to Nuclear Physics by H Enge, Addison-Wesley Pub.
- Introductory Nuclear Physics by Kenneth S Krane, John Wiley & Sons, Singapore (1988) latest edition
- Fundamentals of Nuclear Physics by J. C. Verma, R. C. Bhandari & D.R.S. Somayajulu (2005) CBS Publishers & Distributers, New Delhi.
- Fundamentals of Nuclear Physics by Jahan Singh, Pragati Prakashan, Meerut 1st ed. 2012.
- Introduction to Particle Physics' by M P Khanna, Prentice Hall of India (1999) New Delhi
- An Introduction to Nuclear Physics' by W N Cottingam & Greenwood, Cambridge Univ. Press UK – latest edition
- Introduction to High energy Physics' by D H Perkins, Addison Wesley
- Introduction to Elementary particles' by David Griffiths, John Wiley & Sons Singapore (1987).
- Introduction To Nuclear And Particle Physics' by R C Verma, V K Mittal S C Gupta, Prentice Hall of India (2009), New Delhi