INDIAN INSTITUTE OF INFORMATION TECHNOLOGY
DESIGN AND MANUFACTURING (IIITD&M) KANCHEEPURAM

INTRODUCTION OF NEW COURSE

<table>
<tr><td>Course Title</td><td>Nuclear Physics</td><td>Course No
(will be assigned)</td><td colspan="4"></td></tr>
<tr><td>Specialization</td><td>Physics</td><td>Structure (LTPC)</td><td>3</td><td>1</td><td>0</td><td>3</td></tr>
<tr><td>Offered for</td><td>PG/Ph.D</td><td>Status</td><td colspan="2">Core ☐</td><td colspan="2">Elective ■</td></tr>
<tr><td>Faculty</td><td>Dr. Tapas Sil</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Modification ☐</td></tr>
<tr><td>Pre-requisite</td><td>Basic quantum mechanics</td><td>To take effect from</td><td colspan="4">January 2013</td></tr>
<tr><td>Submission date</td><td>October 2012</td><td>Date of approval by AAC</td><td colspan="4"></td></tr>
<tr><td>Objectives</td><td colspan="6">To study the basic constituents of matter and the interactions between them. To understand the basic ground-state properties, energetics and macroscopic features of atomic nuclei.</td></tr>
<tr><td>Contents of the course
(With approximate break up of hours)</td><td colspan="6">1. Nuclear Properties (5hrs): Basic nuclear properties: nuclear size, Rutherford scattering, nuclear radius and charge distribution,nuclear form factor, mass and binding energy, Angular momentum, parity and symmetry, Magnetic dipole moment and electric quadrupole moment. Dipole moment of neutron and quark structure of nucleon.

2. Information from two-body bound state (5 hrs): Properties of deuteron, Schrodinger equation and its solution for ground state of deuteron, rms radius, spin dependence of nuclear forces, electromagnetic moment and magnetic dipole moment of deuteron and the necessity of tensor forces.

3. Information from two-body scattering (8 hrs): Experimental n-p scattering data, Partial wave analysis and phase shifts, scattering length, magnitude of scattering length and strength of scattering, Significance of the sign of scattering length; Scattering from molecular hydrogen and determination of singlet and triplet scattering lengths, effective range theory, low energy p-p scattering, Nature of nuclear forces: charge independence, charge symmetry and iso-spin invariance of nuclear forces.

4. α-decay, β-decay and γ-decay(8 hrs): Gamow's theory of α-emission,β emission and electron capture, Fermi's theory of allowed β decay, Selection rules for Fermi and Gamow-Teller transitions, Parity non-conservation and Wu's experiment.

5. Nuclear Structure (8 hrs): Liquid drop model, Bethe-Weizsacker binding energy/mass formula, Fermi model, Shell model--explanation of shells, masses, magnetic moments, spins and the spectra, with a model core of two particles outside the core. Basic idea of Collective model.
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6. Nuclear Reactions and Fission (8 hrs): Different types of reactions, Quantum mechanical theory, Resonance scattering and reactions; Compound nucleus formation and break-up, Statistical theory of nuclear reactions and evaporation probability, Optical model; Principle of detailed balance, Transfer reactions, Nuclear fission: Experimental features, spontaneous fission, liquid drop model, barrier penetration.</td></tr>
<tr><td>Textbook</td><td colspan="6">1. Kenneth S Krane, Introductory Nuclear Physics, John Wiley and Sons,.</td></tr>
<tr><td>References</td><td colspan="6">1. J. S. Lilley, Nuclear Physics: Principles and Applications, Willey.
2. M.K. Pal: Theory of Nuclear Structure
3. S.N. Ghoshal: Atomic and Nuclear Physics (Vol. 2)
4. M. A. Preston and R. K. Bhaduri : Structure of the Nucleus
5. Samuel S. M. Wong: Introductory Nuclear Physics, Willey.</td></tr>
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