**Nuclear physics 482 -**

**I The nucleus and its particles (2 lectures)**

1. **Basic forces**

Basic forces and sub nuclear particles, exchange character of basic forces, strength of basic forces

**2) Leptons, hadrons and quarks**

**II The nuclear forces (2 lectures)**

**1) The laws of invariance**

1. Two nucleon interaction
2. Conservation of energy
3. Conservation of linear momentum
4. Conservation of angular momentum
5. Conservation of orbital angular momentum
6. Spin and the conservation of the total angular momentum

 **2) Isotopic spin**

 - The generalized Pauli's principle

 - Majorana and Heisenberg exchange operators

 - Properties of the isospin operators

 - Charge symmetry of nuclear forces

 -Charge independence of nuclear forces

1. Conservation of parity
2. Charge conjugation
3. CP violation
4. Time reversal
5. The CPT theorem

**III Nucleon nucleon scattering ( 2 lectures)**

1- Phenomenological potential

 2- Few nucleon system

 3- The theory of scattering

 **4- Nucleon nucleon scattering** ( interaction, n-p scattering, scattering of n by ortho- and para-hydrogen - effective range theory, low energy pp scattering, nn scattering at high energies)

**IV Nuclear Models (2 lecture)**

**1- Types of nuclei**

**2-Nuclear states and level densities**

**3-Clustering in nuclei and nuclear matter**

**4- Models :**

**Types of models**

 Early models

The Fermi Gas model

The Shell model

The rotation model

The vibrational model

The Nilsson model

The alpha particle model

The interacting boson model

**V Nuclear reactions ( 2 lectures )**

-reaction mechanism

-Direct reactions optical model, theory of transition, inelastic scattering

-charge exchange reactions

-nucleon transfer reactions

break up and knock out reactions

compound nucleus reactions

photonuclear reactions

pre-equilibrium reactions

heavy ion reactions