SCPY322
Nuclear and Particle Physics
Second Semester, 2020-21

Udom Robkob, Physics-MUSC

Friday 22, January 2021

Course Proposal:

Introduction into concepts and methods in nuclear and particle physics.

Course description:

Nuclear stability and decay, activity, nuclear models and decays processes, nuclear reactions, interaction of nuclear radiation with matter, relativistic kinematics, additional quantum numbers, quark models, and fundamental interactions

Lecture topics:

1. Nuclear phenomenology
2. Nuclear force and potential
3. Nuclear models
4. Nuclear decay processes
5. Nuclear reaction (cross section)
6. Interaction of nuclear radiations (with matter)
7. Experimental nuclear and particle physics
8. Relativistic kinematics of energetic particle
9. Particle classification and additional quantum numbers
10. Parton and quark models of hadron
11. The standard model
12. Quark masses and flavor dynamics
13. Physics of neutrinos
14. New physics after the LHC

Teaching Method:

1. Lecture, homework, written exams
2. Class web page at URL
   https://physics.sc.mahidol.ac.th/udom/scpy322.html

Reference Materials:

1. Krane, *Introductory Nuclear Physics* (John Wiley)
2. Heyde, *Basic Ideas and Concepts in Nuclear Physics-AN Introductory Approach* (IoP)
3. Martin, *Nuclear and Particle Physics-An Introduction* (John Wiley)
4. Das and Ferbel, *Introduction to Nuclear and Particle Physics* (WSP)
5. Griffiths, *Introduction to Elementary Particle* (John Wiley)
6. Bettini, *Introduction to Elementary Particle Physics* (CUP)
7. Leo, *Techniques for Nuclear and Particle Physics Experiments* (Springer)

Learning Outcome:

After passing the course the student should be able to

- apply the models describing the basic nucleon and nuclear properties
- explain the different forms of radioactivity and account for their occurrence
- calculate the kinematics of various reactions and decay processes by relativistic calculations
- describe the astrophysical processes leading to nuclear synthesis
- account for the fission and fusion processes and the basic properties of the nuclear and fusion reactors
- explain the different processes by which ionising radiation interacts with matter and the functionality of detectors for radioactivity
- classify elementary particles according to their quantum numbers and draw simple reaction diagrams
- classify different kinds of reactions between elementary particles
- master the use of invariant mass for kinematical computations

Assessment:

1. Attendance 10%, 6 homework sets 30%, midterm exam 30%, and final exam 30%
2. Grading: F$<$50, D$<$55, D+$<$60, C$<$65, C+$<$70, B$<$75, B+$<$80, A$\geq$80%