

中文名稱 Course Title: 放射線與物質作用特論

英文名稱 Course English Title: Special Topics on Interaction of Radiation with Matter

學分 Credits: 3

任課教師 Instructor: 林明緯(LIN, MING-WEI)

#### 一 課程說明(Course Description)

This course is designed to provide students a solid foundation associated with the radiation interaction with matter. Students are expected to understand theories and identify mechanisms behind different types of interactions. Several online databases will be introduced to help the students quantify important parameters (cross section, stopping power, range, *etc.*) and solve problems. At the last section, students will be able to integrate their knowledge into the applications of radiation detection and radiation dosimetry.

#### 二 指定用書(Textbooks)

H. Nikjoo, S. Uehara and D. Emfietzoglou, *Interaction of Radiation with Matter*, CRC Press Taylor and Francis Group, 2012.

#### 三 參考書籍(References)

J. K. Shultis and R. E. Faw, *Fundamentals of Nuclear Science and Engineering*, Second Edition, CRC Press Taylor and Francis Group, 2008.

J. E. Turner, *Atoms, Radiation, and Radiation Protection*, Third Edition, Wiley-VCH, 2007.

#### 四、教學方式(Teaching Method)

3 hours lecture per week

#### 五、教學進度(Syllabus)

##### Part I

##### 1. Review of Atomic and Nuclear Structure

##### Radiation Sources

##### 2. Radioactivity

Types of radioactivity

Radioactive decay kinetics

##### 3. X-rays

Generation of X-rays

Characteristic X-rays

##### 4. Radiation from Accelerators

Synchrotron radiation

Proton accelerators

##### Basic Knowledge of Radiation

##### 5. Quantities and Units of Radiation

Radiation fields

Interaction cross section and reaction rate

## Part II

### Directly Ionizing Radiation

#### 6. Interaction of Electrons with Matter

- Energy loss mechanisms
- Stopping power and range
- Cerenkov radiation

#### 7. Interaction of Heavy Charged Particles with Matter

- Energy-loss mechanisms
- Stopping power and range
- Restricted stopping power and linear energy transfer
- Practice with the open source code SRIM/TRIM

### Indirectly Ionizing Radiation

#### 8. Interaction of Photons with Matter

- Photoelectric effect, Compton scattering and pair production
- Attenuation coefficients
- Photonuclear reactions

#### 9. Interaction of Neutrons with Matter

- Scattering
- Neutron interactions
- Neutron activation

## Part III

### Applications

#### 10. Principles of Radiation Detection and Measurement

- Gas-filled detectors
- Scintillation detectors
- Semiconductor detectors

#### 11. Principles of Radiation Dosimetry

- Dosimetric quantities

## 六、成績考核(Evaluation)

First Midterm 30%

Second Midterm 30%

Final 30%

Homework 10%