1. Course description and prerequisites

This course forms an introduction to the processes of photon emission and absorption in astrophysical situations, going mainly with classroom lectures and exercises. No prior knowledge of astronomy is assumed. However, basic physics and algebra at the graduate level will be used extensively. Whenever more advanced physics concepts are required, they will be appropriately introduced. The content includes the following chapters:

Chapter 1 Basic concepts
1-1 Radiative flux and the specific intensity
1-2 The radiative transfer equation
1-3 Blackbody radiation
1-4 The Einstein coefficients
1-5 Random walks
1-6 Radiative diffusion
1-7 Polarization and Stokes parameters

Chapter 2 Radiation from moving charges
2-1 The Liénard-Viechart potential
2-2 Thomson scattering
2-3 Radiation reaction

Chapter 3 Brief review of special relativity
3-1 Lorentz transformation and four vectors
3-2 Covariance of electromagnetic phenomena
3-3 Emission from relativistic particles
3-4 Lorentz invariants

Chapter 4 Bremsstrahlung
4-1 Emission from single-speed electrons
4-2 Thermal Bremsstrahlung emission
4-2 Thermal Bremsstrahlung absorption

Chapter 5 Synchrotron radiation
5-1 Total emitted power
5-2 Spectrum of synchrotron radiation
5-3 Polarization of synchrotron radiation
5-4 Synchrotron self-absorption
Chapter 6  Compton scatterings
6-1 The Klein-Nishina cross section
6-2 Inverse-Compton scatterings
6-3 Repeated Compton scatterings: Kompaneets equation

Chapter 7  Plasma effects
7-1 Faraday rotation

Chapter 8  Atomic structure
8-1 Review of quantum mechanics
8-2 Perturbations and level splittings
8-3 Ionization and the Saha equation

2. Textbook
Radiative processes in astrophysics
Rybicki, G. B., & Lightman, A. P.,

3. References
Astrophysics processes
Bradt, H.

Astrophysical formulae, vol. 1, 3rd Ed.
Lang, K. R.,

Black holes, White dwarfs, and Neutron stars
Shapiro, S. L., & Teukolsky, S. A.

4. Grading policy
Homeworks: There will be regular problem sets, which will make up 30% of the final grade. Students are welcome to work in groups.

In-class tests: There will be two in-class tests (1 hour each), tentatively scheduled for March 26 and April 30. These tests will make up 30% of the final grade.

Final exam: The final exam (3 hours) is scheduled for June 11, which will make up 40% of the final grade.

5. Related website
http://www.asiaa.sinica.edu.tw/ hirotani/