

## Courses included in the agreement UC-Brown

. 6-Credit courses (approx. 60h of programmed lectures or supervised work)

### **Advanced Experimental Techniques:**

This course is carried out in the lab, except for the introduction session. Students carry out 3-4 Experiments of Advanced Level in different fields. They are selected from a pool of experiment that includes, among others:

- Characterization of Laser Diodes.*
- Elements in an optical communication system.*
- Magnetic Materials characterization.*
- Analysis of a light signal by photon counting.*
- Semiconductor detectors for neutrons.*
- High-resolution Gamma Spectroscopy.*

Usually one experiment requires several sessions. For each of them students receive information and are instructed specifically. After each experiment students must present a report and one of them must be presented in the form of a short seminar.

[Written exams: ~0%]

### **Particle Physics:**

This course pursues the understanding of the basic aspects of the so-called Standard Model. It will use the book "Particle Physics", by BR Martin & G. Shaw, Ed Wiley as the main reference. The following is a tentative scheme of the course:

- *Overview. Basic concepts*
- *Experimental techniques: particle detectors and accelerators. Particle colliders*
- *QCD, jets and gluons*
- *Weak interaction: Weinberg-Salam model. Experimental evidence. Higgs' boson*
- *Beyond the standard model: Neutrinos. Super-symmetry. Dark matter.*

The course contains practical computer sessions to illustrate the lessons. From each of them the students will present a report.

[Written exams: ~40%]

### **Astronomy:**

Theoretical sessions will be approximately half of the total and might include lessons on:

- *Observational techniques.*
- *Use of Telescopes.*
- *Solar system, stars, galaxies and structures at larger scales.*
- *Software to reduce astronomical data.*

This course includes experimental sessions in subjects like:

- *Retrieving data from Astronomical databases*
- *Observations with optical telescopes and cameras*
- *Observation with the 2.5m radio telescope at IFCA*
- *Astrometry of asteroids.*
- *Rotation of Mercury.*
- *Classification of Active Galaxies.*

Laboratory work will be assessed by means of short reports presented by the students.

[Written exams: ~60%]

**Also offered –in English- and belonging to the UC Diploma in Physics:**

. 6-Credit courses (approx. 60h of programmed lectures or supervised work)

**Experimental Optics:**

Students will attend some previous sessions to familiarize with the fundamentals of the course. Then they will carry out at least 8 experiments in optics and attend two demonstrative sessions carried out by the teacher. Experiments are usually short, adequate for single-session format. They are related either to basic instrumentation in optics or to particular aspects of physical optics. A tentative list of possible experiments include:

- *Transversal polarization of electromagnetic waves.*
- *Radiometry and photometry laws.*
- *Light dispersion in a prism.*
- *Spectral transmission of color filter.*
- *Digital image processing.*
- *Young's double slit: Interference of two beams.*
- *Newton rings and curvature measurement.*
- *Diffraction grating characterization for atomic spectrum analysis.*
- *Diffraction by simple apertures and obstacles.*
- *Spatial coherence of a monochromatic light source*

Students have to present two written reports and a short (10-15min) seminar, each on one of the experiments.

[Written exams: ~30%]

**Physics of Materials:**

This course contains classroom and laboratory work in approximately the same amount. A tentative program for the theory might include lessons on:

- *Materials and their classification.*
- *Optical properties of materials.*
- *Electric properties and conductivity.*
- *Magnetic properties and phenomena.*
- *Superconductivity*
- *Functional and nanostructured materials.*

Laboratory work includes a report on the experiments performed by the students. Experiments are on the following aspects:

- *Optical absorption spectroscopy and the electronic structure.*
- *Emission spectroscopy: photoluminescent materials.*
- *Electric resistivity in metals. Temperature effects.*
- *Ferromagnetic materials: hysteresis loop in hard and soft materials.*

[Written exams: ~50%]