TEACHING APPRAISAL

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Teaching Responsabilities :

1. <u>*Assistant Trainee*</u>

   − > **1986 –1989 — University of Minho, Department of Mathematics:**

   - *Mechanics* (Mathematics - fourth year): 30 students, 2-3 hours per week plus 3 hours availability outside class; 90% students sucess
   - *Complex Analysis* (Engineering - second year): 80 students, 3 hours per week plus 3 hours availability outside class; 70% students success
   - *Probability and Statistics* (Engineering - second year): 80 students, 3 hours per week plus 3 hours availability outside class; 70% students success
   - *Analysis–Differential Equations* (Mathematics - second year): 60 students, 3 hours per week plus 3 hours availability outside class; 75% students success

   − > **1989 – 1990 — Technical University of Lisbon/IST, Department of Mathematics**

   - *Linear Algebra and Analytical Geometry* (Engineering - first year): 80 students, 3 hours per week plus 3 hours availability outside class; 70% students success
   - *Analysis* (Engineering - first year): 80 students, 3 hours per week plus 3 hours availability outside class; 70% students success

   I was responsible for supervisions and elaboration of time-tables.

   My duties included course co-ordination, relating and explain the teaching in the main lectures with exercises solving, supervision of undergraduate/graduate students, active participation in the students assessment process and supporting students with difficulties.

   As a enthusiastic person I also encouraged a closer interaction between teachers and students outside lessons, promoting common teachers and students activities such as sports.

2. <u>*Lecturer*</u> (Tenure track)

   – > 1998 - ... — Universidade da Beira Interior (UBI), Departement of Physics:

   - <u>*Astrophysics*</u> (Physics – 4th year): 20 students, 4 hours per week plus 3 hours availability for supervisions and outside class; 100% students sucess
   - <u>*Modern Physics*</u> (Physics, Chemistry – 2nd year): 200 students, 3 hours per week, plus 2 hours availability for supervisions and outside class; 80% students sucess
   - <u>*History of Sciences*</u> (Physics – 1st year): 40 students, 4 hours per week plus 2 hours availability for supervisions and outside class; 95% students sucess
   - <u>*Foundations of Physics*</u> (IT– 2nd year): 60 students, 4 hours per week plus 2 hours availability for supervisions and outside class; 75% students sucess
   - <u>*General Physics*</u> (Biochemestry–1st year): 120 students, 3 hours per week plus 2 hours availability for supervisions and outside class; 100% students sucess
   - <u>*Topics of Relativity and Cosmology*</u> (Physics – 4th year): 15 students, 5 hours per week plus 2 hours availability for supervisions and outside class; 60% students sucess
   - <u>*Classical Mechanics*</u> (Physics – 2nd year): 20 students, 5 hours per week plus 2 hours availability for supervisions and outside class; 65% students sucess

   I have been the sole responsible for preparing and presenting the lectures (as well as giving supervisions). In addition, the students assessment methods were my task as well as defining the evaluation process.

   I was particularly motivated and led to adopt several *lecturing techniques* I was introduced to in Cambridge. Namely, from several courses promoted by the Committee on the Training and Development of University Teachers and in particular from the book "Effective Teaching in Higher Education", by G. Brown & M. Atkins.

   Lectures usually take 1 hour duration, starting with an opening where I establishe connections/links with previous lectures. Then I proceed with exploring the main issues of the lecture, followed by some examples, exercices, and then more material. I complete the lecture establishing further links, presenting a summary and an outllok regarding the next lectures.

   I often used plenty of overhead diagrams with either figures or summaries, as well as usefull cartoons from Physics Today or Physics World to motivate and keep students alert throughout the lectures.

   Evaluation usually comprises 2 tests and 1 final exam, together with laboratory work and several assignments (theoretical and application questions) during the duration of the courses (1 semester, i.e., 2 terms).

3. *Supervisions/Research* (with Ph.D. students)
   − > DAMTP, University of Cambridge, 1994

   • Quantum Cosmology (Part III[1]): 10 students, 3 hours per week, 100% students success

   Duties comprehend explaining theoretical aspects and problem solving.

   In addition, I had quite a active interaction with Ph.D. research students, working together in many projects leading to publications and assisting them in their research work.

Personal Teaching Approaches :

My own practices and attitudes towards teaching and students learning could be described as follows

- Careful planning of the content, methods and structure of the lessons to connect adequately the theoretical and problem solving lessons.
- Materials and resources were well prepared to foster students learning.
- Students progress were carefully monitored and assessment was made of the students skills through appropriate learning strategies (based on the observation of performance and pieces of work, etc).
- Assessment was diagnostic and corrective but also to encourage further efforts and improvements. Wherever necessary students could be supported outside the lessons.
- Lessons were generally evaluated to inform on future planning and practice. There was a commitment to *find* whether time and effort could be organised towards a better performance. Whenever possible, interaction with students in research projects (applicable to the last years) was offered and students own ideas and contributions encouraged.
- General interest in the lessons and conveying positive expectations.
- Gradual introduction of research ideas and methods to students, by means of specific research assignments within the lecture course and my own research lines[2]. The idea was to make the students interested in persuing additional topics and therefore that some of them become interest in a post-graduation in high energy physics subjects.

[1]The part III course is at the level of a M.Sc. course and is attended by students wanting to qualify for a Ph.D.

[2]See *Research Career* and *Research Programme.* descriptions enclosed separately.

Steps Taken to Evaluate and Improving Teaching :

- Self evaluation,
- Time spent reading books on improving teaching, exchanging experiences and course materials with colleagues
- Feedback from students and reflecting on students outcomes, namely from inquires which the students are requested to fill in and return (adapted and expanded from the book "Effective Teaching in Higher Education", by G. Brown & M. Atkins.

Academic Staff Development Courses - University of Cambridge (1997/98) :

- *Introductory Symposium on Lecturing* - October 1997
- *Workshop on Lecturing* - October 1997
- *Undergraduate Supervision Symposium* - October 1997
- *Getting Started as a Supervisor* - October 1997
- *Preparing for Appraisal* - October 1997
- *Giving more Effective Supervisions* - October 1997
- *Students Selection Interview* - October 1997
- *Determining Priorities and Managing Time* - November 1997
- *More Effective Committees and Meetings* - November 1997
- *Preparing Grant Applications* - November 1997
- *How to Teach Graduate Students* - November 1997
- *Presentation Skills* - November 1997
- *Managing and Development of Effective Teams* - December 1997
- *Press your Point - Communicating with the Media* - December 1997

Lecture Courses

Topics in Relativity and Cosmology – Course content:

- General Relativity
  1. A Review of Special Relativity
  2. The Equivalence Principle Context
  3. Towards a metric theory of Gravity - Differential Geometry: Geodesics, Covariant Derivative and Paralel Transport

4. Curvature in Space and Time
5. Matter and Tensors
6. Einstein equations
7. The Schwarzschild solution
8. Gravitational Waves

- Relativistic Cosmology

  1. The expanding universe: Observational support
     - Extra-galactic scales
     - Cosmological Redshift
     - Hubble's law
     - The cosmic microwave background radiation
  2. FRW models: physical evolution
     - Primordial nucleosynthesis
     - Primordial fluctuations and structure formation
  3. Optional topics
     - Cosmological phase transitions: finite-temperature effective potential
     - The inflationary scenario
     - Topological defects
     - Quantum Gravity

Modern Physics — Course Content:

1. Special Relativity Theory

   - Pre-Relativistic physics *re*visited
   - The Michelson-Morley experiment
   - Special relativity postulates
   - The Lorentz transformations
   - Time dilation and Lenght contraction
   - "Paradoxes"
   - Doppler Efect
   - Relativistic dynamics

2. Introduction to Quantum Theory

- Blackbody radiation and Planck's law
- Photoelectric effect
- Compton scattering
- The Bohr-Rutherford model
- de Broglie's theory
- Heisenberg uncertainty principle
- Schrodinger equation
- The wave function and its interpretations
- Tunnel effect
- Harmonic oscillator
- Spin and Pauli exclusion principle

3. Introduction to Nuclear physics
    - Radioactive decays
    - Radioactive processes
    - Nuclear reactions: fission and fusion
    - Applications of nuclear physics
    - Elementary particles

Astrophysics — Course Content:

1. Celestial Mechanics
    - The models of Ptolomeu and Copernic
    - Keppler's laws
    - Newtonian Mechanics (Tides, rings and planetary atmospheres)
    - Arqueoastronomy
2. Solar System
    - Planetary composition and characteristics
    - Origin and formation
3. Stellar Astrophysics
    - Stellar classification

- Hertzsprung-Russell diagrams
- Stellar evolution: Pre-Main sequence, Main sequence and Post Main Sequence stars
- The Sun and red giants, white dwarfs, neutron stars and pulsars

4. Galaxies
    - The Milky Way morphology
    - Galaxy types: Spirals and Ellipticals
    - Galaxy evolution
    - The issue of Dark Matter
5. Cosmology
    - The expanding universeand extra-galactic scales
    - Cosmological Redshift, Hubble's law, Cosmic Background radiation
    - FRW models: physical evolution

History of Sciences — Course Content

1. From Greece to the Renaissance
    - The Helenic period
    - Plato and Aristoteles
    - The Medieval period and Renaissance
2. The XVII century
    - Scientific method and Galileo
    - Empirism and Mechanicism
    - The Mechanics
    - Optics
3. The XVII and XIX century
    - The cultural context
    - General features of Physics
    - Thermodynamics
    - The development of Optics

- Electricity and Magnetism

4. The XX century

    - The advent of atomic physics
    - Two fundamental problems
    - The Revolution - part I: Relativity Theory
    - The Revolution - part II: Quantum Physics
    - Contemporary Physics

Foundations of Physics – General Physics — Course Content:

1. Introduction to vectorial calculus - I
2. Kinematics and Dynamics
    - Motion and Relativity
    - Newton Laws
    - Work and Energy
    - Linear momentum and colisions
3. Waves and Vibrations
    - The harmonic oscillator
    - Waves and their propagation
    - The Doppler effect
    - Difraction and Interference
4. Thermodynamics
    - Heat and temperature
    - The 1st and 2nd law if Thermodynamics
    - Entropy
    - The kinetic theory
    - Phase transitions
5. Introduction to Vectorial Calculus - II
6. Electricity and Magnetism

- Electric Field
- Electric current (DC) and Ohm's law
- Electric circuits and Kirchoff's law
- Magnetic field and Biot-Savart law
- Electromagnetic field and Faraday's law
- Electric current (AC)

Lecture Courses - *Proposals*

Quantum Cosmology — Course content:

- Parametrized particle dynamics
- Feynman path integral in non-relativistic quantum mechanics
- Hamiltonian description of general relativity
- Path integral in quantum gravity
- Mini-superspace models
  Bosonic matter fields
  Fermionic matter fields
- Canonical quantization of supergravity
- Supersymmetric minisuperspaces and quantum states

Geometrical Methods in Theoretical Physics — Course content:

- Basic principles and applications of Differential Geometry
  Differentiable manifolds and coordinate systems
  Tangent vectors, tensor fields and metrics
  Lie derivatives and brackets, invariances and symmetries (isometries)
- Differential forms
  Exterior derivative, wedge product, Hodge product, volume form
  Fibre and vector Bundles, connections

- Group theory

  Lie groups and algebras

- Applications to physics

  Classical mechanics

  Gauge theories (Electromagnetism and particle physics)

  General Relativity

  Supersymmetric Quantum mechanics

  String Theory

Supergravity and String Theory — Course content:

- Supersymmetry algebra
- Lagrangians for supersymmetry

  (Chiral and vector superfields)

- Pure supergravity

  The Noether procedure

- Coupling of supergravity to matter

  Chiral and vector supermultiplets

  Spontaneous supersymmetry breaking and related effects

- The bosonic string

  Equations of motion, mode expansion and quantization, light cone gauge

  Visasoro algebra

- The superstring

  Equations of motion, mode expansion and quantization, light cone gauge

- Compactifictions, heterotic string,
- Dualities in string theory and recent developments