



**INSTITUTO DE FÍSICA**  
FACULTAD DE FÍSICA

COURSE	:	<b>QUANTUM CHROMODYNAMICS</b>
TRANSLATION	:	CROMODINÁMICA CUÁNTICA
NUMBER	:	FIM3400
CREDITS	:	15 UC / 9 SCT
MODULES	:	2 THEORETICAL
REQUISITES	:	FIM3406
CONECTOR	:	AND
RESTRICTION	:	030401, 030501
CHARACTER	:	OPTATIVE
FORMAT	:	THEORETICAL LECTURES
QUALIFICATION	:	STANDARD
KEY WORDS	:	QUANTUM CHROMODYNAMICS, THEORY OF STRONG INTERACTIONS
FORMATIVE LEVEL	:	MAGISTER
DISCIPLINE	:	PHYSICS

**I. COURSE DESCRIPTION**

This course goes into different aspects of Quantum Chromodynamics (QCD), the theory of strong interactions, emphasizing both theoretical as well as phenomenological aspects.

**II LEARNING OUTCOMES**

To achieve a modern understanding of the dynamics of strong interactions in the perturbative regime, (Operator Product Expansion (OPE), DGLAP and BFKL evolution equations, and various examples) phase diagram of QCD)

**III. CONTENTS**

1. General properties of hadrons and Quark Model. Parton Model and various applications specially to Bjorken's scaling in electron-proton deep inelastic
2. QCD Lagrangian. Global symmetries (light quarks and heavy quarks)
3. Quantization of gauge theories and renormalization group.
4. Feynman rules for the QCD, asymptotic freedom and several applications: Bjorken's scaling violation from the perspective of the OPE, electron-positron sector and hadronic jets, Drell-Yan process, heavy flavors decay, physics of two photons
5. DGLAP evolution equations
6. BFKL evolution
7. Some ideas about QCD Sum Rules and other non-perturbative scenarios like Instantons and Pomerons.
8. Inclusion of thermal effects and the phase diagram of QCD. Applications to relativistic heavy ion collisions.

**IV. METHODOLOGICAL STRATEGIES**

- Two weekly sessions
- Homeworks, Lecture of review articles and book chapters
- One oral presentation (a seminar)



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**V. EVALUATIVE STRATEGIES**

- Two Tests: I1, I2 (33% each one)
- Homeworks (H) (assignments) (17% in total)
- Oral presentation (17%)
- Mark = [ I1 + I2 + (<H> + Oral Presentation) ] / 3

**VI. BIBLIOGRAPHY**

**REQUIRED**

- S. Narison: QCD as a Theory of Hadrons (From Partons to Confinement).  
Cambridge Monographs on Particle Physics,  
Nuclear Physics and Cosmology, 2004
- R. K. Ellis, W. J. Stirling, B. R. Webber: QCD and Collider Physics.  
Cambridge Monographs on Particle  
Physics, Nuclear Physics and Cosmology,  
2004
- W. Greiner, A. Schäfer: Quantum Chromodynamics, Springer Verlag 1995
- P. Pascual, R. Tarrach: QCD: Renormalization for the Practitioner, Lecture  
Notes in Physics, Springer, 1985

Some Physics Reports review articles and conference

**OPTIONAL**

N/A