UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Mathematical Methods for Physics

2425-1-F1701Q098

Aims

Group theory and its applications to theoretical physics.

Contents

Lie groups, Lie algebras; their representations.

Detailed program

Basic definitions

- Definition of a group; subgroups, homomorphisms, representations.
- conjugate, invariant subgroups; quotient group;

Finite Groups

- Cyclic group, dihedral group, group of permutations

Representations

- Unitary representations, their classification, orthonormality and completeness, Regular representation. Irreps of SO(3)

Lie groups

- Manifolds, Lie groups, Lie algebras, generators, exponential map.
- Examples of Lie groups: orthogonal, unitary, Lorentz, Poincaré. SU(2) and SO(3)

Lie algebras

- Definition, simple and semi-simple algebras. Killing form.

Classification of Lie Algebras

- Cartan subalgebra, Root systems, Dynkin diagrams.

Prerequisites

Undergraduate degree in math or physics

Teaching form

Lessons (6 CFU), This course will be taught in English.

Textbook and teaching resource

Lecture notes uploaded on the course webpage.

Group Theory:

- Wu-Ki Tung, *Group Theory in Physics*
- Georgi, *Lie Algebras in Particle Physics.*
- Keski-Vakkuri-Montonen-Panero, *Mathematical Methods for Physics - An Introduction to Group Theory, Topology and Geometry*
- Fulton-Harris, *Representation theory*, Springer.

Further readings:

- Gilmore, *Lie Groups Lie Algebras and some of their applications,* Dover.
- Gilmore, *Lie Groups, Physics and Geometry*, Cambridge.
- Cornwell, *Group Theory in Physics*, Academic Press.

Semester

First semester

Assessment method

Oral exam. Open questions on all course's topics covered during the lectures.

Office hours

By appointment, by sending an e-mail to *mattia.bruno@unimib.it*

Sustainable Development Goals

QUALITY EDUCATION