UNIVERSITÀ DI PAVIA

Anno Accademico 2018/2019

MATHEMATICAL METHODS OF THEORETICAL PHYSICS

Enrollment year	2018/2019
Academic year	2018/2019
Regulations	DM270
Academic discipline	FIS/02 (THEORETICAL PHYSICS, MATHEMATICAL MODELS AND METHODS)
Department	DEPARTMENT OF PHYSICS
Course	
Curriculum	Fisica teorica
Year of study	1°
Period	2nd semester (04/03/2019 - 14/06/2019)
ECTS	6
Lesson hours	48 lesson hours
Language	Italian
Activity type	ORAL TEST
Teacher	PERINOTTI PAOLO (titolare) - 6 ECTS
Prerequisites	Undergraduate Mathematical Methods, Mechanics, Electrodynamics and Quantum Mechanics.
Learning outcomes	Introduction to the mathematical methods of theoretical Physics with case studies applications to relativity, gauge and quantum field theories.
Course contents	Differentiable manifolds, vector bundles, principal bundles. Vector fields on a manifold, flow of a vector field, Lie derivative. Linear connection on a vector bundle. Connections as 1-forms with value in the Lie algebra of a Lie group. Parallel transport. The Exponential map. Curvature and holonomy of a connection. Bianchi identities and their geometrical meaning. Curvature tensor. Metrics on a manifold, compatibility with a linear connection. Connections and Yang-Mills fields. Gauge invariance. Yang-Mills equations and their variational derivation. The example of the electromagnetic field. Linear connections on the tangent bundle and

	Levi-Civita connections. Geodetics and their properties. The Ricci tensor. Isometries and Killing vectors. Geometrical analysis. Differential operators on manifolds and partial differential equations. Banach spaces of sections. L^p and Sobolev Spaces. Elliptic, parabolic, and hyperbolic operators. Examples and applications. The spectral theorem. The spectrum of the Laplace-Beltrami operator on a compact manifold. Applications. Functional determinants and partition functions in quantum field theory and statistical mechanics.
Teaching methods	Teaching consists in blackboard lectures, during which the teacher describes the mathematical objects the course deals with, shows their properties, and proves the main theorems involving them.
Reccomended or required readings	Manfredo do Carmo, Riemannian Geometry, Birkhauser Boston Y. Choquet- Bruhat, C. DeWitt-Morette, Analysis, Manifolds and Physics, North-Holland J. Jost, Riemannian Geometry and Geometric analysis, Springer
Assessment methods	The examination is oral. The first subject is chosen by the student. Subsequent questions are aimed at ascertaining completeness of preparation, as well as the ability to autonomously use the tools learnt in the course.
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Sustainable development goals - Agenda 2030	$lbl_legenda_sviluppo_sostenibile