

Qualifying Examination Syllabus for An Huang

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Committee members:

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1, Algebraic topology

Fundamental group, covering spaces, CW complex, simplicial homology, singular homology, cellular homology, M-V sequences, De Rham cohomology, concepts of connection and curvature, singular cohomology, Cech cohomology, cup product, Borsuk-Ulam theorem, Lefschetz fixed point theorem, fundamental class and Poincare duality, some applications of Lerray-Serre spectral sequence, stable homotopy groups for classical Lie groups.

2, Representation theory of Lie algebras

- Basics about representation of finite groups: Schur's Lemma, Characters, group algebra, Young diagrams and representations of S_n
- Lie theory: The exponential map, semisimple Lie algebras, Lie's theorem and Engel's theorem, Killing form, Weyl character formula and an application to the standard model: the eightfold way, irreducible representations of classical Lie algebras, classification of complex simple Lie algebras

3, Quantum Field Theory

Canonical quantization of Klein-Gordon field and Dirac field, interaction picture and S-matrix, time-product and Wick's theorem, Feynman propagators, Feynman diagram rules for QED, Compton scattering on the tree

level, renormalized perturbation theory, basic ideas of renormalization group in QFT, Yang-Mills lagrangian and the basic correspondences between differential geometry and gauge field theories, GWS theory of electroweak interactions.