

Oral Qualifying Exam Syllabus

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1. Dynamical systems

- Ordinary Differential Equations
 - Existence, Uniqueness, Dependence on parameters
 - Invariant sets, fixed points, periodic orbits, limit sets
 - Linear Theory
 - Stability of fixed points, periodic orbits
 - Hartman-Grobman Theorem
 - Floquet Theory
 - Liapunov Functions
 - Poincare-Bendixson Theorem
 - Stable manifold theorem
- Bifurcation Theory
 - 1-dim: Saddle-node, Transcritical, Pitchfork, Cusp bifurcations
 - 2-dim: Saddle-node, Pitchfork, Hopf, Homoclinic, Heteroclinic bifurcations
- Conley Index Theory
 - Isolating neighborhoods, Isolated invariant sets, Isolating blocks
 - Wazewski principle
 - Index pairs, Conley Index
 - Morse Decompositions, Attractor-Repeller Pair Decomposition,
 - Fundamental Theorem of Dynamical Systems
 - Connecting homomorphism, Connection Matrix Theory

2. Algebraic Topology

- Simplicial, singular and cellular homology and cohomology
- Axioms for general homology theory, Dimension Axiom
- Mayer-Vietoris
- Universal Coefficient Theorems
- Cup and Cap Products
- Kunneth Formula
- Poincaré Duality
- Tor, Ext

References

- [1] Robinson, C. *Dynamical Systems: Stability, Symbolic Dynamics, and Chaos*. CRC Press, 1999.
- [2] J. Hale, H. Koçak, *Dynamics and Bifurcations*. Springer-Verlag, 1991.
- [3] Mischaikow, K., Mrozek, M., *Conley index theory*. Handbook of Dynamical Systems II: Towards Applications, (B. Fiedler, ed.), North-Holland, 2002.
- [4] Hatcher, A., *Algebraic Topology* Cambridge University Press, 2002.
- [5] Weibel, C., *An Introduction to Homological Algebra*. Cambridge University Press, 1994.