Differential equations I, Math. 820

MWF, 0330PM, CC 214

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This quarter we will study the fundamental notions important in understanding differential systems and continuous dynamical systems.

The prerequisites are: elementary theory of differential equations, complex analysis.

- Contractive mapping principle, existence and uniqueness of solutions.
- Lower order systems, phase portraits.
- (Existence and uniqueness theorems; more general results)
- Singularities of linear systems.
  - Singularities of the first kind (or Fuchsian, or regular singularities).
  - Singularities of the second kind.
  - Normal forms.
- Eigenvalue problems; completeness of eigenvectors.
- Integrable and chaotic systems. Criteria of solvability.
- Equilibria.
- Stability (local, global, asymptotic). Lyapounov functions
- The Poincaré-Bendixson theorem.

- Global nonlinear techniques.
- Integrability versus chaos.

Other subjects will be added, if they are of special interest to students.

References

[1] E.A. Coddington and N. Levinson, *Theory of Ordinary Differential Equations*, McGraw-Hill, New York, (1955).

[2] M.W. Hirsch, S. Smale and R.L. Devaney *Differential Equations, Dynamical Systems and an Introduction to Chaos*, 2nd Edition, Elsevier, New York, (2004).

[3] V.I. Arnold, *Geometrical Methods in the Theory of Ordinary Differential Equations*, 2nd edition, Springer, (1996).