SYLLABUS for MATH 256

I] First Order ODEs: Preliminaries
- A) Initial Value Problem
- B) Graphs
  - (No crossing)

II] Finding Explicit Solutions of Certain First Order ODEs
- A) Basic Integrable
- B) Separable
- C) Linear First Order
- D) First Order Homogeneous

III] Story Problems and Applications
- A) Mixing
- B) Populations

IV] What to Do When You Can't Solve a First Order ODE
- A) Numerical Treatment
- B) Direction Fields and Graph Sketches
- C) Phase Portraits
  - (1 Dimensional)
- D) Equilibria and Stability
  - (Compare with Phase Portraits)

V] Second Order ODEs: Preliminaries
- A) Initial Value Problem
- B) Graphs
  - (Crossing allowed)

VI] Second Order ODEs That Reduce to First Oder
- A) Missing Dependent Variable
- B) Missing Independent Variable

VII] Linear Second Order ODEs: Preliminaries
- A) Existence and Uniqueness of Solutions for the Initial Value Problem
- B) Vector Spaces and Linear Operators
  - 1) Theory of vector spaces
    - (linear independence, bases)
  - 2) Theory of linear operators and their kernels
- C) Applying Vector Space Theory to Linear ODEs
  - 1) Superposition of Solutions
  - 2) Homogeneous and Nonhomogeneous Linear ODEs
  - 3) General Solutions of Linear ODEs
- D) Finding the General Solution of a Second Order Linear Homogenous ODE When You Know One Solution

VIII] Solving Second Order Linear ODEs with Constant Coefficients
- A) Homogeneous
  - Use h(t) =esp(kt) ansatz
    - 1) 2 real roots

2) Double real root
3) Complex roots
B) Story Problems
(Oscillators, circuits)
C) Inhomogeneous
1) y(t)= h(t) + p(t)
2) Finding p(t)
D) Comments on Higher Order Linear ODEs with Constant Coefficients

IX] Linear First Order Systems
A) Preliminaries
1)What They Look Like
2) Where They Come From
a> Interacting populations
b> First Orderizing Higher Order ODEs
3) Initial Value Problem
B) Model Story Problems
C) Explicit Solutions for Semi-Decoupled First Order Systems
D) Homogeneous Constant Coefficient Linear First Order Systems
1) Explicit Solutions
a> (X(t), y(t)) = (v, w) exp(rt) Ansatz
---> Eigenstuff problem
b> The eigenvalues and eigenvectors and the solutions
2) Qualitative anlaysis
a> Direction fields on phase portraits
(i) sketching
(ii) the zoo of phase portraits
(classified by eigenstuff)
b> Equilibria and stability