

FINAL PRACTICE GUIDE PROBLEMS 106

- Review Practice material for Midterm.
- Review the canonical forms corresponding to different matrices.
- Solve using exponential matrices non-homogeneous systems of the type

$$X' = \begin{pmatrix} 1 & -1 \\ 1 & 3 \end{pmatrix} X + \begin{pmatrix} \sin t \\ t \end{pmatrix}$$

with data $X(0) = \begin{pmatrix} 1 \\ 0 \end{pmatrix}$

- Picard iteration method , problems from page 156 , problems like 1,2,3,4.
- Be able to work with existence and uniqueness theorems from chapter 7.
- be able to use Theorem on continuous dependence of data. See example on page 147.
- What is the difference between a conserved quantity for a system of ODE and a Hamiltonian, system.
- Be familiar , Hamiltonian systems, gradient systems,
- Know how to work with Hamiltonian functions and Lyapunov functions.
- You should know how to linearize a Nonlinear system.
- If the system is Hamiltonian use the level curve to help you sketch the phase portrait.
- How do Lyapunov functions work?
- Check if a system is Hamiltonian and find the Hamiltonian function.
- What kind of equilibrium points can a Hamiltonian system have.
- Be able to analyze the stability of critical points
- Be able to work out problems like Problem 1 of page 497.
- Check the stability (stable , asymptotically stable or unstable) of systems like

$$\begin{aligned}x' &= -x^3 + xy^2, \\y' &= -2x^2 - y^3.\end{aligned}$$

- Find a positive definite function $V = ax^2 + cy^2$, which is Lyapunov for the system above.
- Need to know what are nullclines and separatrices.