SYLLABUS

Math 119A, Winter 2012, Temple

DAY	SECTION	HOMEWORK
MO – Jan 9	**Introduction/Chapter 1**	**Read Chapter 1 : Overview**
WE – Jan 11	§**2.1 – 2.4** :	**2.1.1, 2.1.2, 2.1.3**
FR – Jan 13	§**2.6 – 2.7**	**2.2.4, 2.2.7, 2.2.9**
MO – Jan 16	**Martin Luther King Day**	
WE – Jan 18	**Lecture – Existence/Uniqueness**	**2.2.13abc, 2.4.7**
FR – Jan 20	**Lecture – Contract. Map/Picard**	**S1, S2, S3** (below)
MO – Jan 23	§**2.6, 2.7**	**2.6.2, 2.7.1**
WE – Jan 25	§**3.5**	**3.5.1 – 3.5.3**
FR – Jan 27	§ **3.1 – 3.2**	**3.1.4, 3.1.5, 3.2.4, 3.2.6, 3.2.7**
MO – Jan 30	§ **3.2 – 3.4**,	**3.3.1abc, 3.4.2, 3.4.4, 3.4.5, 3.4.6, 3.4.8**
WE – Feb 1	§ **3.4 – 3.5**	**3.4.11, 3.4.12, 3.4.14**
FR – Feb 3	**Midterm**	
MO – Feb 6	**Lecture – Dimensional Analysis**	
WE – Feb 8	§**3.5 – Dimensional Analysis**	**3.5.7, 3.5.8**
FR – Feb 10	§ **5.1**	**5.1.1, 5.1.9**
MO – Feb 13	§ **5.2**	**5.2.1, 5.2.2**
WE – Feb 15	§ **5.2**	**5.2.4, 5.2.8**
FR – Feb 17	§ **5.2**	**5.2.13**
MO – Feb 20	**Presidents′ Day**	
WE – Feb 22	§**6.1 – 6.2**	(**Homework 3.5.7 – 5.2.13 Due**)
FR – Feb 24	§ **6.3**	**6.1.2, 6.1.3, 6.1.12,**
MO – Feb 27	§ **6.4**	**6.3.1, 6.3.3, 6.3.6, 6.3.12, 6.4.1**
WE – Feb 29	§ **6.5**	**6.5.1, 6.5.3**
FR – Mar 2	§ **6.6**	**6.6.5, 6.6.7, 6.6.10**
MO – Mar 5	§ **6.7**	**6.5.14**
WE – Mar 7	**Lagrange′s Equations**	
FR – Mar 9	**Lagranges′s Equations**	**Homework Chapter 6 Due**
MO – Mar 12	**Bead on Rotating Hoop**	**S4, S5**
WE – Mar 14	§ **7.2**	**7.2.1, 7.2.2, 7.2.10**
MO – Mar 16	§ **7.1, 7.3**	**7.1.1, 7.1.2, 7.1.3, 7.1.7, 7.3.1, 7.3.4**
FR – Mar 19	**Exponential of a Matrix**	

(0.1)

SUPPLEMENTAL HOMEWORK PROBLEMS

(S1) Consider the Ricotti equation $\dot{x} = x^2$. (a) Draw the phase portrait for solutions. (b) Obtain the exact formulas for solutions in the two cases when the initial data $x(0) = x_0$ lies on either side of the rest point $x = 0$. (c) Show that this initial value problem meets the assumptions of the local existence Theorem (1) for each x_0. (d) Show that this equation does not meet the assumptions of the global existence Theorem (2) when $x_0 > 0$. (See Lecture 3-PhasePortraitScalar-1-13-12.)

(S2) Consider the initial value problem $\dot{x} = x^{2/3}$, $x(0) = 0$. (a) Show there are two solutions that solve this initial value problem, namely $x(t) = 0$ and one you can get by separation of variables.(b) Explain why this initial value problem does not meet the assumptions of the local existence Theorem (1) (See Lecture 3-PhasePortraitScalar-1-13-12.)

(S3) Consider the linear ODE $\dot{x} = k\,x$ with initial condition $x(0) = x_0$. Find the solution, and show that the Picard approximations $x_n(t)$ converge to this solution as $n \to \infty$. (See Jan. 20 lecture notes.)

(S4) Consider the Langrangian $L(x, \dot{x}) = x^2\dot{x}^4 - \sin x$.

(i) Derive Lagranges second order equation.

(ii) Define the generalized momentum p and find the function $\dot{x} = f(x, p)$.

(iii) Find the generalized energy $E(x, \dot{x})$ and the Hamiltonian

$$H(x, p) = E(x, f(x, p)).$$

(iv) Find Hamilton's equivalent first order system.

(S5) Consider the nonlinear pendulum: a mass m at the end of a rigid massless rod of length r fixed at a frictionless pivot at the opposite end, swinging in a plane under the downward force of gravity. (See text.)

(i) Derive the second order equations using Lagrange's Principle.

(ii) Non-dimensionalize to get the equation $\ddot{\theta} + \sin\theta = 0$. Linearize at $\theta = 0$ and obtain the harmonic oscillator.

(iii) Find the energy and the Hamiltonian and write Hamilton's first order equations.