

# APMA 1930M: Homework Assignment # 2

Due: 10/09/14

## Problem 1 Two-term composite expansion

Consider the problem

$$\begin{cases} \epsilon y'' + y' = 2x \\ y(0) = 0 \text{ and } y(1) = 0 \end{cases} .$$

1. Determine a two term outer expansion.
2. Determine a two term inner expansion.
3. Match these two expansions and form a composite expansion.
4. Using Mathematica or some other software, create three plots of your two term composite expansion plotted on the same axis as a numerical solution for the values  $\epsilon = .5$ ,  $\epsilon = .1$  and  $\epsilon = .05$ .

## Problem 2 Book problems

Complete exercise 2.1, 2.3

## Problem 3 Steady state heat flow

For one-dimensional non-dissipative steady state flow, heat transfer is governed by the equation

$$\begin{cases} \epsilon \frac{d^2 T}{dx^2} + x \frac{dT}{dx} - xT = 0 \\ T(0) = T_l \text{ and } T(1) = T_r \end{cases} .$$

For  $T_l = 0$  and  $T_r > 0$  determine a first order composite expansion for the solution to this problem.

## Problem 4 Nonlinear problem

Determine one-term expansion for the solutions of the problems

$$\begin{cases} \epsilon y''(x) \pm (2x + 1)y'(x) + y^2 = 0 \\ y(0) = 0 \text{ and } y(1) = 1 \end{cases} .$$