AUBURN UNIVERSITY
SAMUEL GINN
COLLEGE OF ENGINEERING
AEROSPACE

AERO 4790/7970 Advanced Perturbation Methods SET V

The Latta Method of Composite Expansions MCE

1. Use Latta's Method of Composite Expansions to solve:

$$\begin{cases} \varepsilon y'' - y' = 2x \\ y(0) = A, \qquad y(1) = B \end{cases} \tag{1}$$

2. Use Latta's Method of Composite Expansions to solve the heat transfer equation representing one-dimensional nondissipative steady flow viz.

$$\begin{cases} \varepsilon \dfrac{\mathrm{d}^2 T}{\mathrm{d}x^2} + x \dfrac{\mathrm{d}T}{\mathrm{d}x} - xT = 0 \\ T(0) = T_L, \qquad T(L) = T_R \end{cases} \tag{2}$$

Ref: Hanks, T.C. (1971), Model relating heat-flow value near, and vertical velocities of mass transport beneath, ocean rises. *Journal of Geophysical Research*, Vol. 76, pp. 537-544.

3. Use Latta's Method of Composite Expansions (MCE) to determine a first-order uniformly valid expression for a one-dimensional boundary layer equation of the form:

$$\begin{cases} \varepsilon y'' - a(x) y' + b(x) y = 0, \qquad a(x) > 0 \quad \forall x \\ y(0) = A, \qquad y(1) = B \end{cases} \tag{3}$$