



AUBURN UNIVERSITY

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AEROSPACE

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AERO 4970/7970

Advanced Perturbation Methods  
The Generalized Scaling Technique GST

SET VII

1. Use the Generalized Scaling Technique to solve:

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

2. Use the Generalized Scaling Technique to solve the heat transfer equation representing one-dimensional nondissipative steady flow viz.

$$\begin{cases} \varepsilon \frac{d^2 T}{dx^2} + x \frac{dT}{dx} - xT = 0 \\ T(0) = T_L, \quad T(L) = T_R \end{cases} \quad (2)$$

Recall the leading order solution contains a singularity.

3. Use the Generalized Scaling Technique to determine a uniformly valid expression for a one-dimensional boundary layer equation of the form:

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

If  $a(x)$  vanishes inside the domain, it marks the presence of a *turning point*. The treatment of turning point problems is covered in Perturbation Methods by Nayfeh (1973).