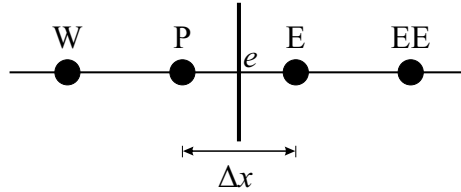


1. What are the advantages and disadvantages of Exponential scheme?
2. Derive a 4th order relation for  $\phi_e$  and  $\frac{d\phi}{dx}|_e$  using W and EE points.



3. Show the correctness of the Central Difference Scheme, Upwind Method and Power Law Method by recalculating their results comparing with Exact Solution derived from exponential formula. Do these comparisons for  $Pe$  numbers  $0, \pm 2, \pm 4, \pm 6, \pm 8, \pm 10$ .

Use the following table relations to develop your computer code.

Method	$A( Pe )$
Central Difference	$1 - 0.5 Pe $
Upwind	1
Hybrid	$\max[0, 1 - 0.5 Pe ]$
Power Law	$\max[0, (1 - 0.1 Pe )^5]$
Exponential	$\frac{ Pe }{\{\exp( Pe ) - 1\}}$

4. Consider the steady 1D convection-diffusion problem discussed in this chapter. Assume a nonuniform grid (i.e.,  $\Delta x_e \neq \Delta x_w$ ). Hence, derive expressions for  $a_E$ ,  $a_W$ , and  $a_P$  using the power law scheme.

**Hint:** Start with these Equations:

$$\begin{aligned} \phi_e &= \psi\phi_P + (1 - \psi)\phi_E \\ \phi_w &= \psi\phi_W + (1 - \psi)\phi_P \end{aligned}$$

Where  $\psi$  is a function of  $Pe$  number.

