Conduction Logic
Road Map

Is the system at Steady State?

no

Bi < 0.1?

no

What is Fo?

Note: Charts or full series expansion can be used in all cases

Fo < a

Semi-infinite solution

a < Fo < b

Must use charts or series expansion

b < Fo

1-term solution

Solve using lumped capacitance

Is there 1D Heat Transfer?

no

Is the aspect ratio large and Bi < 0.1 in the small direction?

no

Compute resistances. Is there heat generation?

yes

\[ \frac{d}{dx} \left( k \frac{dT}{dx} \right) = 0 \]

yes

\[ \frac{d}{dx} \left( k \frac{dT}{dx} \right) + q = 0 \]

Is it a special shape?

no

Use Chap. 4 ideas (sep. of variable, flux plots, shape factor)

yes

Write energy balance in differential form

Fourier Number cutoffs:

<table>
<thead>
<tr>
<th></th>
<th>a</th>
<th>b</th>
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<tbody>
<tr>
<td>Plane Wall</td>
<td>0.1</td>
<td>0.2</td>
</tr>
<tr>
<td>Cylinder</td>
<td>0.06</td>
<td>0.15</td>
</tr>
<tr>
<td>Sphere</td>
<td>0.04</td>
<td>0.1</td>
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Only first term of summation matters

Use charts or series expansion to solve

System effectively semi-infinite

Lumped analysis

Surface T responds in a step change

Bi or BiFo^{1/2} (whichever is less)

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