Suggested cases to add to Exact Analytical Conduction Toolbox

K. Cole, August 2018

A. HEAT EQUATION

1. 1D Cartesian: X30B0T1, X30B0Gx5T0

2. Two-dimensional Cartesian (steady or unsteady)

    Slab: X00Y33 heated at boundary, internally, initially

    Semi-slab X30Y33, heated at boundary, internally, initially

    Quarter space X30Y30, heated at boundary, internally, initially

    Rectangle X33Y33, heated at boundary, internally, initially

3. Three dimensional Cartesian (steady or unsteady)

    Infinite plate (or slab) X00 Y00 Z33

    Half space X30 Y00 Z00

    Quadrant X30 Y30 Z00; Octant X30 Y30 Z30

4. 1D Cylindrical cases

    a. solid: R03B1T0, R03B0T1, R03B0T5, R03B0Gr5T0

    b. hollow: R33B01T0, R33B00Gr5T0

5. 2D Cylindrical cases (steady or unsteady)

    a. finite cylinder with circular symmetry RIJZML

    b. infinite slab with circular symmetry R00ZML

    c. full circle RIJphi00; wedge of circle RIJphiKL

6. 3D Cylindrical cases

    a. full cylinder RIJz33phi00, R0Jz33phi00

    b. wedge of cylinder RIJz33phiKL, R0Jz33phiKL

7. Spherical

    a. 1D solid: RS02B0T5, RS02B0Gr5T0, RS03B1G1T1

    b. 1D hollow shell: RS33B00Gr5T0, RS33B00T5

    c. 2D or 3D applications?

B. BIOHEAT EQUATION (fin equation)

1. Cartesian cases

   a. 1D: slab X33B11F1Gx5T1

   semi-infinite XJ0B1F1Gx5T1

   infinite X00F1Gx5T5

   b. 2D: rectangle XIJB00YKLB00F1G1T1

   slab XIJB00Y00F1G1T1

   c. 3D: parallelepiped XIJB00YKLB00ZMNB00F1G1T1

   slab XIJB00Y00Z00F1G1T1, etc.

2. Cylindrical cases

   a. 1D: solid R03B0F1G1T1

   hollow RIJB00F1G1T1, RIJB10F1T0

   infinite body R00Gr5F1T5

   b. 2D: halfspace with circular symmetry, XJ0R00F1, variously heated

   semi-infinite solid cylinder XJ0B0R03B0F1G1T1

   semi-infinite hollow cylinder XJ0B0R33B0F1G1T1

   disk R03B0phi00F1G1T1, variously heated

   c. 3D cylinder R03B0Z33B00Phi00F1G1T1, variously heated

3. Spherical cases

   a. 1D: solid RS03B0F1Gr5Tr5

   hollow RSIJB00F1Gr5T5

   b. 2D or 3D applications?

C. HEAT EQUATION WITH CONVECTIVE TERM

1. Cartesian, steady

a. 2D: $\frac{u}{\alpha}T_x = T_{yy}$ (boundary layer)

$\frac{u}{\alpha}T_x = T_{xx} + T_{yy}$ (X00Y33V1, flow between plates)

b. 3D: $\frac{u}{\alpha}T_x = T_{xx} + T_{yy} + T_{zz}$ (X00Y33Z33V1, rectangular channel)

2. Cartesian, transient

a. 1D: $\frac{1}{\alpha}T_t + \frac{u}{\alpha}T_x = T_{xx}$ (X00V1G5T5)

b. 2D: $\frac{1}{\alpha}T_t + \frac{u}{\alpha}T_x = T_{yy}$ (boundary layer)

$\frac{1}{\alpha}T_t + \frac{u}{\alpha}T_x = T_{xx} + T_{yy}$ (X00Y33V1T0, flow between plates)

3. Cylinder, steady

a. 2D: $\frac{u}{\alpha}\frac{\partial T}{\partial x} = \frac{1}{r}\frac{\partial}{\partial r}\left(r\frac{\partial T}{\partial r}\right)$ (boundary layer)

$\frac{u}{\alpha}\frac{\partial T}{\partial x} = \frac{1}{r}\frac{\partial}{\partial r}\left(r\frac{\partial T}{\partial r}\right) + T_{xx}$ (X00R03V1 tube; X00R33V1 annulus)

b. 3D: $\frac{u}{\alpha}\frac{\partial T}{\partial x} = \frac{1}{r}\frac{\partial}{\partial r}\left(r\frac{\partial T}{\partial r}\right) + T_{xx} + \frac{1}{r^2}T_{\emptyset\emptyset}$ (tube with angular dependence)

4. Cylinder, transient. Etc.