

Heat Transfer on TK
(Based on Fundamentals of Heat and Mass Transfer by Incropera and DeWitt)

Here is a listing of the topics covered by the collection of TK Solver math models.

CONDUCTION

1D STEADY-STATE

THERMAL RESISTANCE

- Plane Wall
- Cylindrical Wall
- Spherical Shell
- Convection Process
- Radiation Exchange

COMPOSITE WALL

- Plane Wall - 4 Sections
- Cylindrical Wall - 4 Sections
- Spherical Shell - 4 Sections
- Series-Parallel Wall A
- Series-Parallel Wall B

INTERNAL ENERGY GENERATION

- Asymmetric Plane Wall
- Solid Cylinder
- Solid Sphere
- Asymmetric Composite Wall

FINS

- Straight Fin, Triangular Cross Section
- Straight Fin, Parabolic Cross Section
- Annular Fin, Rectangular Profile
- Circular Pin Fin; Convective Tip
- Circular Pin Fin; Adiabatic Tip
- Circular Pin Fin; Fixed Tip Temperature
- Uniform Rectangular Fin; Convective Tip
- Uniform Rectangular Fin; Adiabatic Tip
- Uniform Rectangular Fin; Fixed Tip Temperature

2D STEADY-STATE

SHAPE FACTORS

- Sphere in Semiinfinite Medium
- Horizontal Cylinder in Semiinfinite Medium
- Vertical Cylinder in Semiinfinite Medium
- Disk on a Semiinfinite Medium
- Two Cylinders in Infinite Medium
- Horizontal Circular Cylinder Between Planes
- Circular Cylinder in a Square Solid
- Eccentric Circular Cylinder in a Cylinder
- Conduction Through Wall Edges
- Conduction Through Wall Corners

RECTANGULAR CROSS-SECTION

- Internal Generation and Convection
- Matrix Solver

1D TRANSIENT

LUMPED CAPACITANCE

- Convection Only
- General Analysis

UNIFORM INITIAL TEMPERATURE

- Plane Wall
- Cylinder

Sphere

NON-UNIFORM INITIAL TEMPERATURE

Plane Wall

SEMIINFINITE MEDIA

Sudden Surface Temperature Change

Sudden Surface Heat Flux Applied

Sudden Surface Convection Process Applied

2D TRANSIENT

Internal Generation and Convection - Rectangular Cross-Section

CONVECTION

EXTERNAL FLOW

FLAT PLATES

Laminar Flow - Uniform Surface Temperature

Laminar Flow - Uniform Heat Flux

Laminar Flow - Unheated Starting Length

Turbulent Flow - Uniform Surface Temperature

Turbulent Flow - Uniform Heat Flux

Turbulent Flow - Unheated Starting Length

Mixed Flow - Uniform Surface Temperature

CYLINDERS

Hilpert Correlation

Zhukauskas Correlation

Churchill-Bernstein Correlation

NON-CIRCULAR, IN CROSS-FLOW

Square - Horizontal Diagonal to Flow

Square - Side Normal to Flow

Hexagon - Side Normal to Flow

Hexagon - Side Parallel to Flow

Plate - Normal to Flow

SPHERES

Whitaker Correlation

Falling Drop - Modified Ranz-Marshall Correlation

TUBE BANKS

Zhukauskas Correlation - Aligned Tubes

Zhukauskas Correlation - Staggered Tubes

INTERNAL FLOW

FULLY DEVELOPED FLOW

CIRCULAR TUBES

Laminar Flow - Constant q_s''

Laminar Flow - Constant T_s

Turbulent Flow - Dittus-Boelter Correlation

Turbulent Flow - Seider-Tate Correlation

Turbulent Flow - Liquid Metals - Constant q_s''

Turbulent Flow - Liquid Metals - Constant T_s

Laminar or Turbulent Flow, Constant q''

Laminar or Turbulent Flow; Constant T_s

Pressure Gradient and Friction Factor

NONCIRCULAR TUBES

Rectangular - Constant q_s''

Rectangular - Constant T_s

Triangular - Constant q_s''

Triangular - Constant T_s

ANNULUS IN LAMINAR FLOW

Outer Tube T_{so} - Inner Adiabatic

Inner Tube T_{si} - Outer Adiabatic

Uniform Heat Flux on Both Surfaces

ANNULUS IN TURBULENT FLOW

Outer Tube Tso - Inner Adiabatic

Inner Tube Tsi - Outer Adiabatic

Uniform Heat Flux on Both Surfaces

ENTRANCE REGION

Combined Entry Length, Constant Ts, Sieder-Tate Correlation

FREE CONVECTION

PLATES

Vertical Plate

Hot Surface Up

Hot Surface Down

Inclined Plate

CYLINDERS

Long Horizontal Cylinder - Morgan Correlation

Long Horizontal Cylinder - Churchill Correlation

SPHERES

Sphere - Churchill Correlation

ENCLOSURES

Rectangular - Horizontal, Heated from Below

Long Horizontal Cylinders

Spheres

DIMENSIONLESS GROUPS

Biot Number (Bi)

Biot Number for Mass Transfer (Bi_m)

Bond Number (Bo)

Coefficient of Friction (Cf)

Colburn j Factor (jH)

Colburn j Factor for Mass Transfer (jm)

Eckert Number (Ec)

Fourier Number (Fo)

Fourier Number for Mass Transfer (Fo_m)

Friction Factor (f)

Grashof Number (Gr_L)

Jakob Number (Ja)

Lewis Number (Le)

Nusselt Number (Nu_L)

Peclet Number (Pe_L)

Prandtl Number (Pr)

Reynolds Number (Re_L)

Schmidt Number (Sc)

Sherwood Number (Sh_L)

Stanton Number (St)

Stanton Number for Mass Transfer (St_m)

Weber Number (We)

RADIATION

DIFFUSE GRAY SURFACES

VIEW FACTORS

2D GEOMETRIES

Parallel Plates - Midlines Connected by Perpendicular

Parallel Plates - Inclined of Equal Width and Common Edge

Perpendicular Plates - Common Edge

Three Sided Enclosure

Parallel Cylinders of Different Radii

Cylinder and Parallel Rectangle

Infinite Plane and Row of Cylinders

3D GEOMETRIES
 Aligned Parallel Rectangles
 Coaxial Parallel Disks
 Perpendicular Rectangles With a Common Edge
 ENCLOSURES - RADIATION EXCHANGE
 2 SURFACE ENCLOSURES
 Large (Infinite) Parallel Plates with Shields
 Long (Infinite) Concentric Cylinders with Shields
 Concentric Spheres with Shields
 Small Convex Object in Large Cavity (Surroundings)
 General Case
 3 SURFACE ENCLOSURES
 Three Surface Enclosure with One Surface Reradiating
 Coaxial Parallel Disks, With Connecting Reradiating Surface
 General Case
 SPECTRALLY SELECTIVE SURFACES
 Hemispherical from Directional Emissivity
 Total from Spectral Emissivity
 Hemispherical from Directional Absorptivity
 Total from Spectral Absorptivity - Piecewise Distribution
 Total from Spectral Absorptivity - Blackbody Irradiation
 Total from Spectral Reflectivity - Piecewise Distribution
 Total from Spectral Reflectivity - Blackbody Irradiation
 Total from Spectral Transmissivity - Piecewise Distribution
 Total from Spectral Transmissivity - Blackbody Irradiation
 BLACKBODY RADIATION
 Spectral and Total Emissive Power
 Wein's Displacement Law
 Band Emission
 RADIATION PROCESSES
 Irradiation from Directional Intensity - Spectral Band
 Radiosity from Directional Intensity - Spectral Band
 Emissive Power from Directional Intensity, Spectral Band (1)
 Emissive Power from Directional Intensity, Spectral Band (2)
 Emissive Power from Directional Intensity, Spectral Band (3)

 MULTIMODE HEAT TRANSFER
 ISOTHERMAL PLATES
 Flat Plate Solar Collector
 Isothermal Plate - One Surface
 Isothermal Plate - Two Surfaces
 Three Surface Enclosure with One Surface Reradiating
 PLANE WALLS
 Spectrally Selective Surfaces, Large Surroundings
 Two Surface (2-3) Enclosure
 TUBE
 Internal Turbulent Flow with External Cross Flow

 HEAT TRANSFER WITH PHASE CHANGE
 BOILING
 Nucleate Pool Boiling
 Minimum Heat Flux, Leidenfrost Point
 Film Pool Boiling - Water; Cylinder or Sphere
 External Forced Convection Boiling
 CONDENSATION
 Vertical Plate - Laminar Film
 Vertical Plate - Turbulent Film

Film Condensation - Spheres or Horizontal Tubes
Film Condensation - Horizontal Tubes, Vertical Tier
Inside Horizontal Tubes

HEAT EXCHANGERS

OVERALL HEAT TRANSFER COEFFICIENTS

Convection - Wall Resistance

Tubular Type - Finned

Tubular Type - Unfinned

LOG MEAN TEMPERATURE DIFFERENCES

Parallel or Counterflow Types

TUBES

CONCENTRIC

Parallel Flow

Counterflow

SHELL-TUBE & CROSS FLOW TYPES

Shell-Tube - One Shell Pass

Shell-Tube - n Shell Passes

Cross Flow - Both Fluids Unmixed

Cross Flow - Cmin Unmixed and Cmax Mixed

Cross Flow - Cmin Mixed and Cmax Unmixed

All Exchangers - Boiling or Condensation

MASS TRANSFER

CONVECTION, FLAT PLATE

Parallel Turbulent Flow

Parallel Flow, Mixed Conditions

DIFFUSION

1D STATIONARY MEDIA

SPECIFIED SURFACE CONCENTRATIONS

Plane Media

Cylindrical Media

Spherical Media

SPECIFIED SOLUBILITY AT SURFACES

Plane Media

Cylindrical Media

Spherical Media

SPECIAL APPLICATIONS

Catalytic Surface Reactions

Equimolar Counter Diffusion

Evaporation in a Column

Gas A through Liquid B with Reactions

PROPERTIES

Solids

Fluids

UNITS