TRANSIENT HEAT TRANSFER

Governing Equation

$$\frac{\partial T}{\partial t} = \alpha \frac{\partial^2 T}{\partial x^2}$$

RELATIVE IMPORTANCE OF INTERNAL AND EXTERNAL RESISTANCE TO HEAT TRANSFER

Biot Number

$$N_{Bi} = \frac{hD}{k}$$

Negligible internal resistance N_{Bi} <
Negligible surface resistance N_{Bi} >
Finite internal and surface resistance   <N_{Bi}<

NEGLIGIBLE INTERNAL RESISTANCE TO HEAT TRANSFER

$$\ln(T_a - T) = \frac{hAt}{\rho c_p V}$$

NEGLIGIBLE SURFACE RESISTANCE TO HEAT TRANSFER

Infinite Slab

series solution

similar expressions for infinite cylinder and sphere
use Figures 4.35, 4.36, 4.37
FINITE SURFACE AND INTERNAL RESISTANCE TO HEAT TRANSFER
series solution
Expressions similar to above are available in literature
Use Figures 4.35, 4.36, 4.37

Fourier Number

$$\frac{\text{Rate of heat conduction across D in volume } D^3 \text{ (W/C)}}{\text{Rate of heat storage in volume } D^3 \text{ (W/C)}}$$

Large value of N_{Fo} indicates deeper penetration of heat into solid in a given period of time.

FINITE OBJECTS

FINITE SLAB

Finite Cylinder