DIGITAL EDUCATION
MARTCOST

CHEMICAL ENGINEERING

Heat Transfer

Hand Notes For GATE, IES, PSUs & Competitive Exam

Hand Notes

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HEAT TRANSFER

1) Conduction :- 15 hrs
2) Convection :- 20 hrs
3) Radiation :- 8 hrs

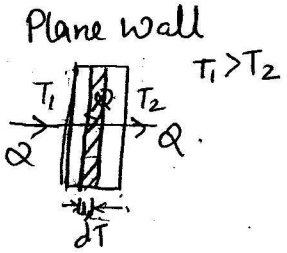
Heat Exchanger } 6 hr
Condensation, Boiling } 4 hr

Conduction :-

Fourier's law :-

$$\frac{Q}{A} \propto \frac{dT}{dx}$$

Heat flux Temp. gradient



A = Area normal to the direction of Heat transfer.

$$\frac{Q}{A} = -k \frac{dT}{dx}$$

k = constant of proportionality. (Thermal conductivity of material)

$$Q = -kA\, dT/dx$$

$$\frac{J}{S} = k\, m^2 \frac{K}{m}$$

$$k = \frac{J}{s\,m\,K} = W/mK$$

More H.T → Conduct Mat.
Less H.T → Insulator Mat.

Assumption :-

1) Isothermal Surfaces.
2) Constant Thermal Conductivity in the given range of temp.
3) Whatever heat enters, nothing is retained, entire amt of heat leaves the other side.
4) Steady state.
5) One-dimensional heat transfer (x-direction)

$Q = -kA\,dT/dx$

$dx = -kA\,dT/Q$

$\int_1^2 dx = \int_1^2 -\frac{kA}{Q}\,dT$

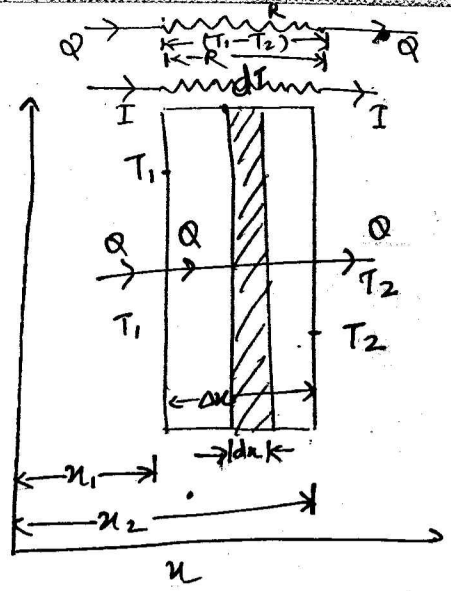
$x|_{x_1}^{x_2} = -\frac{kA}{Q}\,T|_{T_1}^{T_2}$

$x_2 - x_1 = -\frac{kA}{Q}(T_2 - T_1)$

$= \frac{kA(T_1 - T_2)}{Q}$

$Q = \frac{kA(T_1 - T_2)}{(x_2 - x_1)}$

$= \frac{kA(T_1 - T_2)}{\Delta x}$



Ohm's law

$I = V/R$

$Q = \frac{T_1 - T_2}{\Delta x/kA}$

Thermal Resistance $R_t = \Delta x/kA = \frac{m}{W/mK \times m^2} = K/W$

Convection :—

Newton - Rikhman's law

Heat flux $\propto$ Temp. diff.

$\frac{Q}{A} \propto (T_w - T_\infty)$

$\frac{Q}{A} = h(T_w - T_\infty)$

↳ Constant of proportionality

↳ Convective heat transfer co-efficient / film coeff.

$Q = hA(T_w - T_\infty)$

$J/s = h\,m^2 K$

$h = J/sm^2K = W/m^2K$