# Introduction of Heat transfer:

## Method of Heat transfer:

- → Conduction
- → Convection
- → Radiation

## Newton's Law of Cooling:

Heat transfer from a hot body to a cool body is directly proportional to the surface area and difference of temperatures between the two bodies.

## Fourier's Law of Heat Conduction:

Amount of heat flow in unit time : $Q \propto A \times \frac{dT}{dx}$

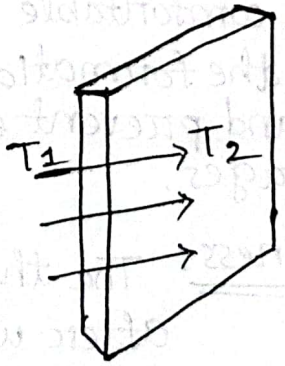
$$\therefore Q = KA \frac{dT}{dx}$$

where, $K$ = Thermal conductivity of the body.
$dx$ = Thickness

$\rightarrow K = \frac{Q dx}{A dT}$

"The quantity of heat in joules that flows in one second through $1m^3$ of a material when opposite faces maintained at temperatu difference of 1K"

→ Thermal conductivity




Again,

$$Q = KA \frac{dT}{dx}$$

$$= KA \cdot \frac{T_1 - T_2}{dx}$$

Now, for 't' time,

$$Q = KA \frac{(T_1 - T_2)\, t}{x}$$

or, $$Q = \frac{(T_1 - T_2)}{\frac{x}{KA}} \quad [\text{for } t = 1 \text{ sec}]$$

The term $\frac{x}{KA}$ is known as Thermal Resistance.

The term $\frac{T_1 - T_2}{x}$ is known as **Temperature Gradient**.

N.B.

LAB ⟶ Sunday (25/02/2024)
2 पेज.

25/02/2024

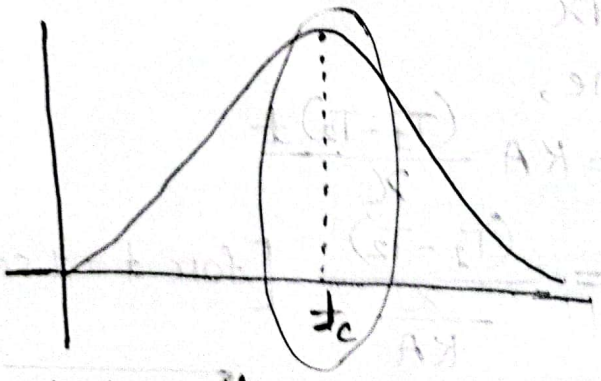
## Purpose and Application of Thermal Insulation:

The main purpose of insulation is to limit the transfer of energy between the inside and outside of a system.

→ Improve Thermal performance.
→ Save energy by reducing the rate of heat transfer.
→ Prevent moisture condensation.
→ Maintain comfortable indoor temperature.
→ Prevent the formation of undesirable compounds such as hydr
→ Protect and prevent electrical & electronic devices from generati high voltages.

**Critical thickness:** The thickness upto which heat flow increases an after which heat flow decreases.

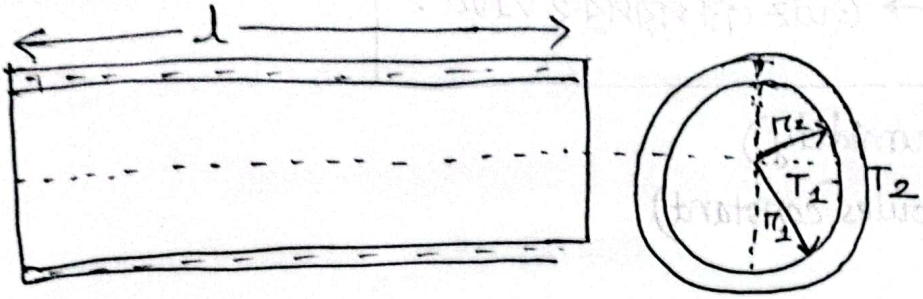
~~Radial Heat Transfer~~




## Radial Heat Transfer by conduction through a Thick cylinder:

P.T.O ⟶

N.B. এখানকার eqn টা থেকে exam এ আসে।




Here,
Thickness of pipe = $r_2 - r_1$
Inside temp. = $T_1$
Outside temp = $T_2$

K → Thermal-conductivity

$\therefore$ Area = $2\pi r l$

$\therefore$ Heat conduction, $Q = KA\left(\frac{-dT}{dr}\right)$

or, $Q = -K \times 2\pi r l \left(\frac{dT}{dr}\right)$

or, $\frac{dr}{r} = \left(-\frac{2\pi K l}{Q}\right) dT$

Integrating both sides,

$$\int_{r_1}^{r_2} \frac{dr}{r} = \frac{-2\pi K l}{Q} \int_{T_1}^{T_2} dT$$

$$\text{or, } \left[\log_e r\right]_{r_1}^{r_2} = \frac{-2\pi K l}{Q} \left[T\right]_{T_1}^{T_2}$$

$$\text{or, } \log_e\left(\frac{r_2}{r_1}\right) = \frac{-2\pi K l}{Q}(T_2 - T_1)$$

$$\text{or, } \log_e\left(\frac{r_2}{r_1}\right) = \frac{2\pi K l}{Q}(T_1 - T_2)$$

$$\text{or, } Q = \frac{2\pi K l}{2.3 \log\left(\frac{r_2}{r_1}\right)}(T_1 - T_2)$$

[একটা সিলিন্ডারের মধ্য দিয়ে conduction এর মাধ্যমে কি পরিমাণ heat transfer হয়, এটা সেটার equation.]

**BTU (British Thermal Unit):** The quantity of heat required to raise the temperature of one pound of water by 1°F.

N.B: 12/03/24 exact 9.45 এ → Quiz (short question আসবে)
→ Quiz এর পরপরই viva.

- Air conditioning (Humidity)
- Heat Transfer (Joules constant)
- Turbine
- Boiler
- IC engine (2-stroke, 4-stroke IC engine)
- [redacted] (Load calculation) V.V.I

CT-05: 10/02/24 → 9.45
Topic:

LAB

25/02/24

## Refrigeration Load calculation for a cold storage:

Cooling Load:

1. Transmission Loads (5-15%)
2. Product Loads (55-75%)
3. Internal Loads (10-20%)
4. Equipment Loads (1-10%)
5. Infiltration of air (1-10%)

} Total load

(1) Transmission load calculation এর eqn টা লিখবা + Example দিবা,
(2) Product কর্তৃক produce কৃত heat টাও reduce করতে হবে,
(3) Light ব্যবহার করা হয়.... eqn লিখে একটা example আছে, সেটা দিবা,
(4) Evaporator, condenser, coils etc. এগুলো কর্তৃক produce কৃত heat টাও reduce করতে হবে।
(5) factory'র দরজা খুললে বাইরে থেকে air আসতে পারে,

Objective:

Theory: Load calculation কেন দরকার?

- 4 types, প্রত্যেকটাতে 1 line করে লিখবা,
- eqn আছে, সেটা লিখবা,

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**Air Conditioning এর math exam এ → must** 27/02/24

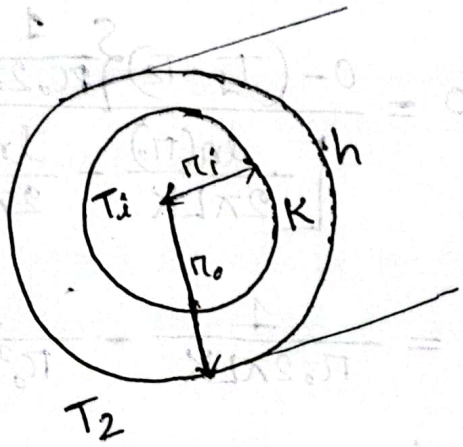
## Critical radius for cylinder:

h → heat transfer coefficient

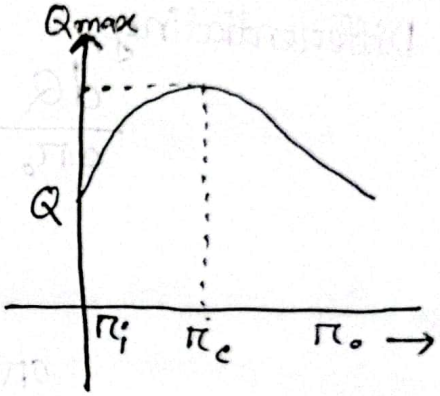
$r_i$ → inside radius

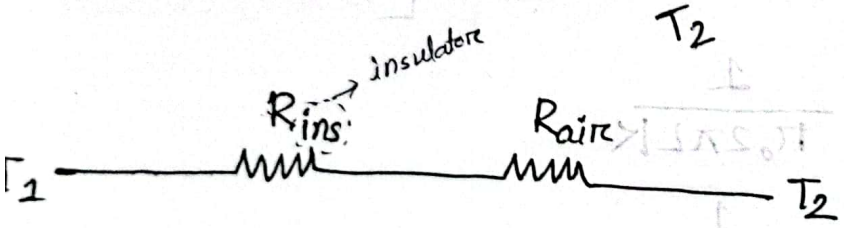
$r_o$ → outside radius

K → thermal conductivity




h → heat transfer coefficient




$$\left[Q = \frac{T_1 - T_2}{\frac{\ln(r_2/r_1)}{2\pi L K}}\right]$$

$\frac{\ln(r_2/r_1)}{2\pi L K}$ → R

We know that,

Total resistance, $Q = \frac{T_1 - T_2}{\sum R}$ ——— (i)

$\therefore \sum R = R_{insulator} + R_{air}$

$= R_{Conductive} + R_{conductive}$

$= \frac{\ln\left(\frac{r_o}{r_i}\right)}{2\pi L K} + \frac{1}{h_o \times 2\pi r_o L}$

$$Q = \frac{T_1 - T_2}{\left[\frac{\ln\left(\frac{r_o}{r_1}\right)}{2\pi l K}\right] + \left[\frac{1}{h_o 2\pi r_o L}\right]}$$

$$= \frac{T_1 - T_2}{\left\{\frac{\ln(r_o)}{2\pi l K} - \frac{\ln r_1}{2\pi L K}\right\} + \frac{1}{h_o 2\pi r_o L}}$$

Now, Determine the value of $r_o$ (when Q become max.), $\frac{dQ}{dr_o} = 0$

Differentiating,

$$\frac{dQ}{dr_o} = 0 = \frac{0 - (T_1 - T_2)\left\{\frac{1}{r_o 2\pi L K} - 0 + \frac{-1}{r_o^2 2\pi L h_o}\right\}}{\left[\frac{\ln(r_o)}{2\pi L K} - \frac{\ln(r_1)}{2\pi L K} + \frac{1}{r_o 2\pi L h_o}\right]^2}$$

$$\text{or, } 0 = \frac{1}{r_o 2\pi L K} - \frac{1}{r_o^2 2\pi L h_o} \quad \left[\frac{du}{dv} = \frac{v du - u dv}{v^2}\right]$$

$$\text{or, } \frac{1}{r_o 2\pi L K} = \frac{1}{r_o 2\pi L K}$$

$$\text{or, } \frac{1}{r_o h_o} = \frac{1}{K}$$

$$\text{or, } h_o r_o = K$$

$$\therefore r_o = \frac{K}{h_o}$$

Therefore,

$$r_c = r_o = \frac{K}{h_o} \quad [\text{Critical radius}]$$

Air conditioning : Example – (38.1 ~ 38.5)

[Page : 825-832]

Heat Transfer : [34.4, 34.6, 34.7, 34.10]

[Page: 740-746]

Assignment → ~~36~~ marks

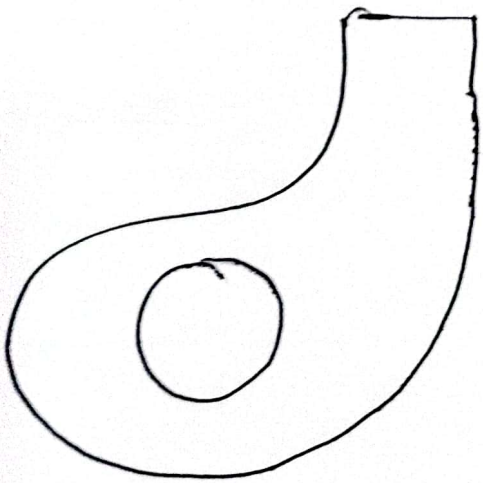
CT-05 → 7.5

Assignment লিখে আনার পর, 4 টা extra offset page আনবা-এগুলোতে CT দিয়ে assignment এর সাথে staple করে দিতে হবে

Centrifugal Pump: (কেন্দ্রবহির্মুখী) Turbine ↔ Pressure → Kinetic energy (K.E.)

↳ K.E. → Pressure

A mechanical device designed to move a fluid by means of the transfer of rotational energy from one or more driven rotors (called impeller)



H.W: [Figure + (3-4) line এর working process]

↳ Function of centrifugal pump.

28/02/2024

**Blowers:**

Blowers distribute air and generate airflow by acting as a fan.

**Compressor:**

A compressor moves gas or air from one point to another by leveraging pressure.

**H.W** ① Difference between blowers and compressors.
② Application of Blowers and compressors.

**CT-05:** 9.45 (19/03/24) + Assignment
- 9.45 → (7.5 marks)
- Assignment → (6 marks)

**12/03/24**

Quiz → exact 9.45
lap report → spiro bind

- Thermodynamics
- Thermodynamic cycle + engines

  section-A
- IC engine
- Boiler
- Refrigerator
- Air conditioning
- Turbine
- Thermal . . . . .

বিগত বছরের question solve করা