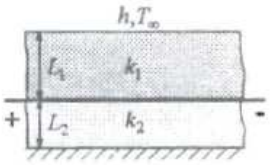
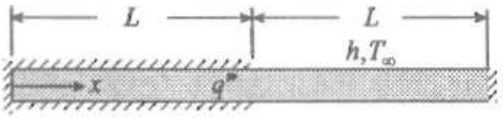
مساله ۱ :

A thin electric element is wedged between two plates of conductivities k_1 and k_2. The element dissipates uniform flux q''_o. The thickness of one plate is L_1 and that of the other is L_2. One plate is insulated while the other exchanges heat by convection. The heat transfer coefficient is h and the ambient temperature is T_∞. Assume one-dimensional steady state conduction, determine the temperature of the insulated surface.



مساله ۲ :

A constant area fin of length $2L$ and cross-sectional area A_c generates heat at a volumetric rate q'''. Half the fin is insulated while the other half exchanges heat by convection. The heat transfer coefficient is h and the ambient temperature is T_∞. The base and tip are insulated. Determine the steady state temperature at the mid-section. At what location is the temperature highest?

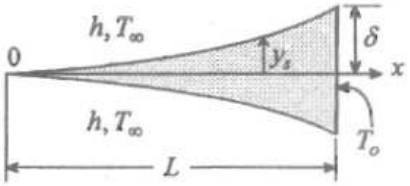


مساله ۳ :

The profile of a straight fin is given by

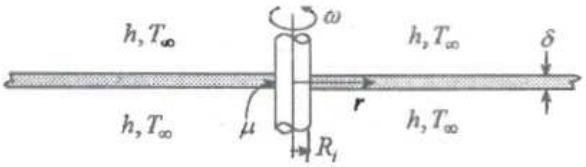
$$y_s = \delta (x/L)^2$$

where L is the fin length and δ is half the base thickness. The fin exchanges heat with the ambient by convection. The ambient temperature is T_∞ and the heat transfer coefficient is h. The base is maintained at T_o. Assume that $(\delta/L) << 1$, determine the steady state fin heat transfer rate.



مساله ۴ :

A very large disk of thickness δ is mounted over a shaft of radius R_i. The shaft rotates with angular velocity ω. The pressure at the interface between the shaft and the disk is P and the coefficient of friction is μ. The disk exchanges heat with the ambient by convection. The heat transfer coefficient is h and the ambient temperature is T_∞. Neglecting heat transfer to the shaft at the interface, use a fin model to determine the interface temperature.



مساله ۵ :

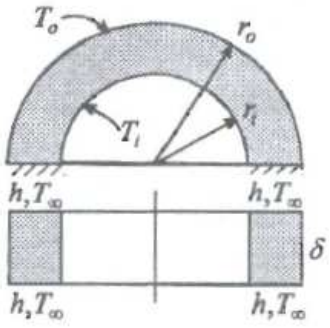
Develop an equation for the critical thickness of insulation for a sphere.

مساله ۶ :

A straight rectangular fin is **4** in wide and **1** in long. It is made of wrought iron and is to be designed for an environment where T_∞ = 60°F and T_w = 600°F; $\bar{h}_c$ can vary from 1 to 50 BTU/(hr·ft²·°R). The fin must transfer 30 BTU/hr. Determine its optimum thickness as a function of $\bar{h}_c$.

مساله ۷ :

Consider steady state two-dimensional conduction in a hollow half disk. The inner radius is r_i, outer radius r_o and the thickness is δ. The disk exchanges heat by convection along its two plane surfaces. The heat transfer coefficient is h and ambient temperature is T_∞. The cylindrical surface at r_i is maintained at T_i and that at r_o at T_o. The two end surfaces are insulated. Determine the steady state temperature distribution in the disk.



مساله ۸ :

در یکی از روزهای زمستان، مسوول انبار یک شرکت بطور اتفاقی سویچ سیستم گرمایشی انبار را قطع می کند. زمانیکه پرسنل شرکت پس از یک تعطیلات طولانی برمی گردند انبار کاملا سرد بوده و رطوبت هوا در برخی قسمتهای کف آن (که بتونی است) بصورت یک لایه یخ به ضخامت 1 mm چگالیده شده است. دمای بتون و زمین زیر آن $-7^\circ C$ می باشد. اپراتور انبار سیستم گرمایشی را روشن کرده و دمای هوا را بسرعت به $15^\circ C$ می رساند. اگر ضریب انتقال گرمای جابجایی بین هوا و کف $15 \quad W/m^2K$ باشد چه مدت طول می کشد که یخ شروع به ذوب شدن کند؟

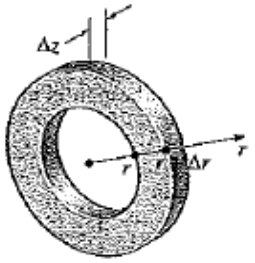
$\alpha_{concrete} = 7\times10^{-7} \quad m^2/s$ $\qquad$ $k_{concrete} = 1.4 \quad W/mK$

ضخامت بتون 250 mm است.

از تقریبها و فرضهای مناسبی بهره بگیرید.

مساله ۹ :

Starting with an energy balance on a ring-shaped volume element, derive the two-dimensional steady heat conduction equation in cylindrical coordinates for $T(r, z)$ for the case of constant thermal conductivity and no heat generation.



مساله ۱۰ :

در جسمی ، معادله هدایت گرمایی به این صورت حاکم است :

$$\frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\frac{\partial T}{\partial r}\right)+\frac{1}{r^2\sin^2\theta}\frac{\partial^2 T}{\partial \phi^2}=\frac{1}{\alpha}\frac{\partial T}{\partial t}$$

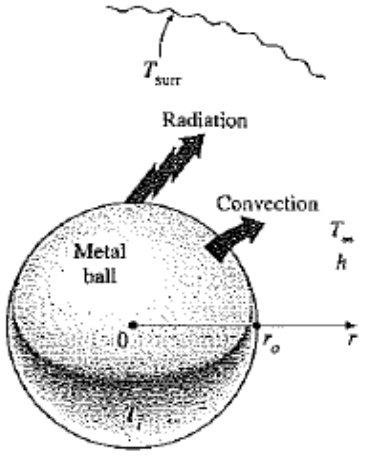
(الف) آیا انتقال گرما پایدار است یا گذرا؟ یک بعدی ، دو بعدی یا سه بعدی اس؟

(ب) آیا تولید یا مصرف انرژی در این ماده داریم؟

(پ) آیا ضریب هدایت گرمایی جسم ثابت است یا متغیر؟

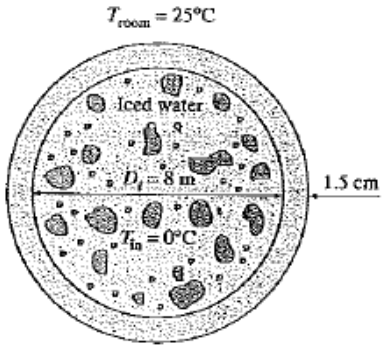
مساله ۱۱ :

A spherical metal ball of radius r_o is heated in an oven to a temperature of T_i throughout and is then taken out of the oven and allowed to cool in ambient air at T_∞ by convection and radiation. The emissivity of the outer surface of the cylinder is ε, and the temperature of the surrounding surfaces is T_{surr}. The average convection heat transfer coefficient is estimated to be h. Assuming variable thermal conductivity and transient one-dimensional heat transfer, express the mathematical formulation (the differential equation and the boundary



مساله ۱۲ :

An 8-m-internal-diameter spherical tank made of 1.5-cm-thick stainless steel ($k = 15$ W/m · °C) is used to store iced water at 0°C. The tank is located in a room whose temperature is 25°C. The walls of the room are also at 25°C. The outer surface of the tank is black (emissivity $\varepsilon = 1$), and heat transfer between the outer surface of the tank and the surroundings is by natural convection and radiation. The convection heat transfer coefficients at the inner and the outer surfaces of the tank are 80 W/m² · °C and 10 W/m² · °C, respectively. Determine (*a*) the rate of heat transfer to the iced water in the tank and (*b*) the amount of ice at 0°C that melts during a 24-h period. The heat of fusion of water at atmospheric pressure is $h_{if} = 333.7$ kJ/kg.



مساله ۱۳ :

Chickens with an average mass of 2.2 kg and average specific heat of 3.54 kJ/kg · °C are to be cooled by chilled water that enters a continuous-flow-type immersion chiller at 0.5°C. Chickens are dropped into the chiller at a uniform temperature of 15°C at a rate of 500 chickens per hour and are cooled to an average temperature of 3°C before they are taken out. The chiller gains heat from the surroundings at a rate of 210 kJ/min. Determine (*a*) the rate of heat removal from the chicken, in kW, and (*b*) the mass flow rate of water, in kg/s, if the temperature rise of water is not to exceed 2°C.

مساله ۱۴ :

An automotive engine can be approximated as a 0.4-m-high, 0.60-m-wide, and 0.7-m-long rectangular block. The bottom surface of the block is at a temperature of 75°C and has an emissivity of 0.92. The ambient air is at 5°C, and the road surface is at 10°C. Determine the rate of heat transfer from the bottom surface of the engine block by convection and radiation as the car travels at a velocity of 60 km/h. Assume the flow to be turbulent over the entire surface because of the constant agitation of the engine block. How will the heat transfer be affected when a 2-mm-thick gunk (k = 3 W/m · °C) has formed at the bottom surface as a result of the dirt and oil collected at that surface over time? Assume the metal temperature under the gunk still to be 75°C.