1) Please derive the governing equation of a heat transfer process in an infinitely long rectangular fin and find the proper boundary conditions. (20%)
2) A long rod made of aluminum oxide has 4 cm in diameter. This rod is initially at T_o=800°K uniformly and is suddenly cooled by a fluid at 200°K having a heat transfer coefficient of 1200 W/m^{2}K. After 30 seconds, the rod is wrapped in well insulation. What will be the temperature of the rod after a long period of time. (For aluminum oxide, ρ=3950 kg/m^3, c_p=1070 J/kgK and k=12.0 W/mK.) (20%)
3) Please explain the physical significance of a) Biot number, b) Nusselt number, c) Prandtl number, d) Reynolds analogy and e) Grashof number. (20%)
4) Start from the idea of energy balance in a control volume, please find $\frac{dT_m}{dx}$ and indicate that it is constant when the pipe wall is heated uniformly. (T_m: mean temperature of the fluid at a given cross section of the pipe; x is the axial distance along the pipe) (20%)
5) Please explain the physical significance of a) blackbody, b) Wien's displacement law, c) diffuse surface, d) Kirchhoff's law and e) view factor. (20%)

(背面仍有題目,請繼續作答)

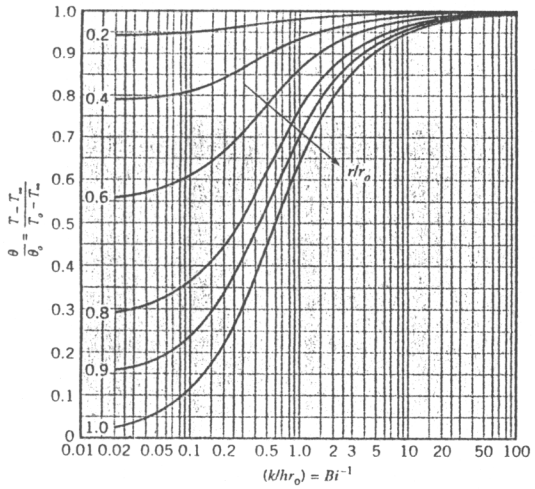

FIGURE D.5 Temperature distribution in an infinite cylinder of radius r_o [1]. Used with permission.

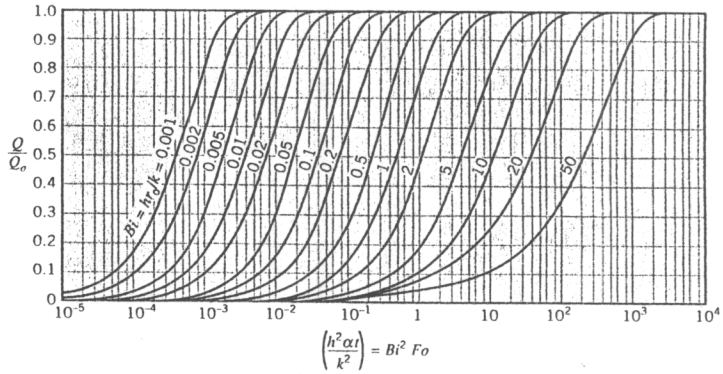

FIGURE D.6 Internal energy change as a function of time for an infinite cylinder of radius r_o [2]. Adapted with permission.

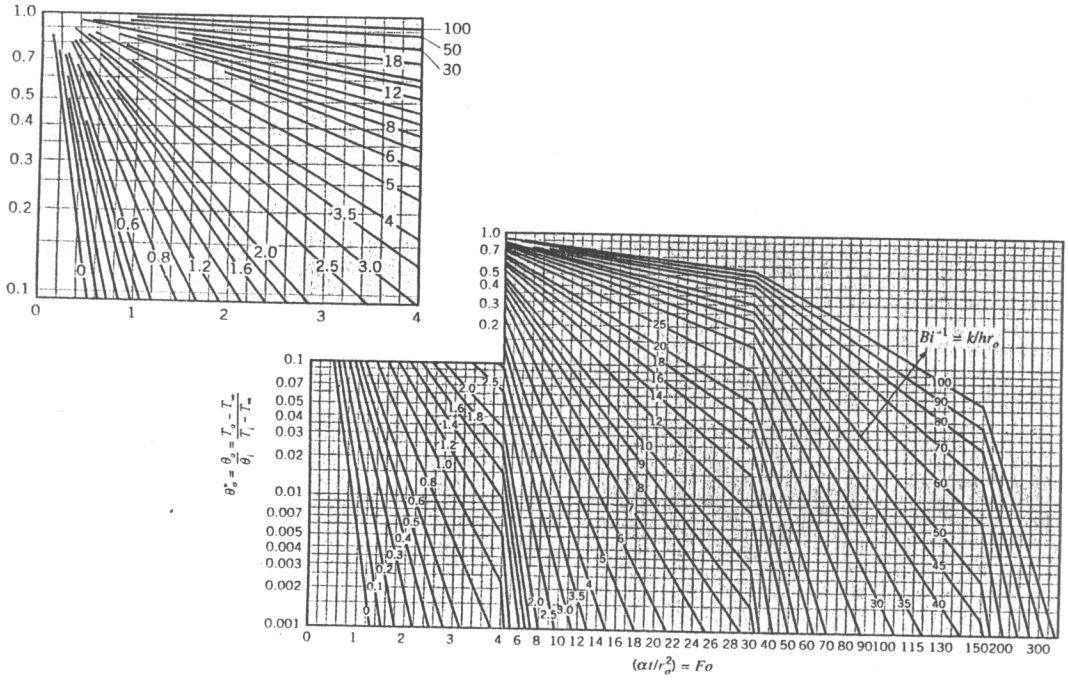

FIGURE D.4 Centerline temperature as a function of time for an infinite cylinder of radius r_o [1]. Used with permission.