國立清華大學命題紙

99學年度 工程與系統科學系乙組 碩士班入學考試

科目 熱傳學 科目代碼 2704 共 1 頁，第 1 頁 *請在【答案卷卡】作答

1. Consider a planer radiation shield, the volumetric heat generation rate due to attenuation of radiation is $q_o\exp(-ax)$. Where a is the attenuation coefficient and x is the distance from the surface exposed to the radiation. Both sides of the shield is cooled by water at temperature T_∞ and heat transfer coefficient h. Please determine the steady state temperature distribution and the maximum temperature in the shield. The thickness of the shield is L and thermal conductivity is k. (20%)

2. The diameter of a silicon wafer is as large as 12 inches nowadays and it is necessary to consider temperature distribution during crystal growth of silicon to warrant the quality of crystal grown. The problem of crystal growth from silicon melt may be approximated as a steady state, axial symmetrical problem in the cylindrical coordinates of r and z dependence. At z=0, the crystal just solidified remains at the melting temperature of silicon as it is the interface of melt and solidified silicon; at the end of the crystal, i.e., z=L, it can be treated as an adiabatic surface; on the crystal surface, i.e., r=R, it is cooled by gas flow combined with thermal radiation with an effective heat transfer coefficient h and fluid temperature is the same as the ambient temperature T_a. The thermal conductivity for the silicon crystal is k. Please solve this steady-state heat conduction problem to obtain an expression for T(r,z) in the crystal. (20%)

3. A plane wall is initially with a temperature distribution F(x),and for $t \geqq 0$ the plane surface at x =0 is kept adiabatic while the surface at x =L is exposed to a fluid at temperature $T_\infty$and heat transfer coefficient h. Determine the transient temperature distribution in the wall. (20%)

4. Considering parallel flow of a liquid metal, with Pr << 1, at temperature T_∞, and free stream velocity U, over a flat plate with surface temperature of T_s, please solve the thermal boundary layer equation and obtain an expression for the local Nusselt number as a function of local Reynolds number and Prandtl number at distance of x from the leading edge. (20%)

5. It is proposed to use waste heat from a hot gas flow at temperature T_g discharged from an industry process to heat up water in a tube with diameter D and flow rate W from room temperature T_a to T_h, which is smaller than the saturation temperature to prevent the water from boiling. It is given that the heat transfer coefficient for the gas side and water side is h_g and h_w, respectively. The thickness and thermal conductivity of the tube wall is d and k, respectively. Determine the length of the tube required. (20%)