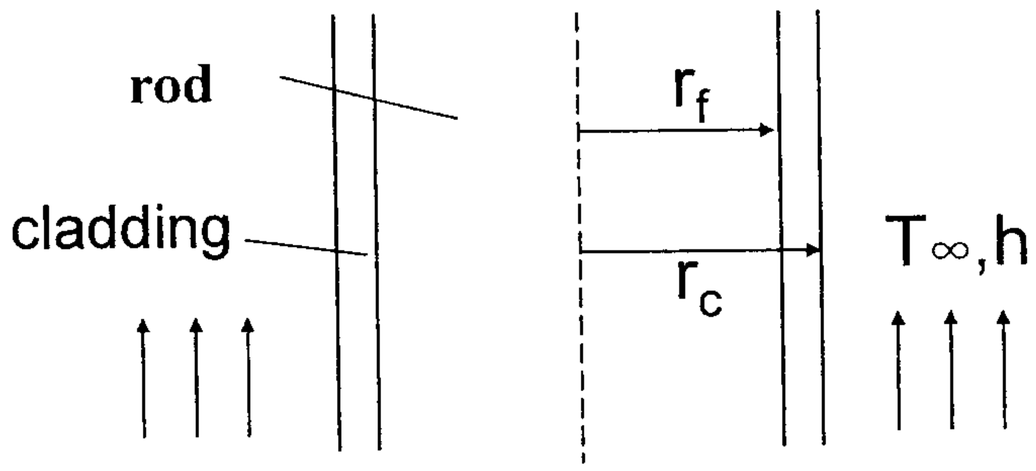
國立清華大學 100 學年度碩士班入學考試試題

系所班組別：工程與系統科學系乙組

考試科目（代碼）：熱傳學(2904)

1. Please give the definition and physical meaning of the following four dimensionless numbers: (a) Reynold number, (b) Prandtl number, (c) Fourier number, (d) Grashof number. You need define the notation used in your definition (20%).

2. Consider a cylindrical rod encased inside a cladding. The thermal conductivity for the cylindrical rod and cladding are k_f and k_c , respectively. The outside radius for the rod and cladding is r_f and r_c , respectively. The volumetric heat generation rate in the rod is uniformly distributed at q'''. The thermal contact resistance between the rod and cladding is R''_c (m^2K/W) for a unit area of interface. The rod is cooled by a coolant at T_∞ with a heat transfer coefficient h. Obtain an expression for the centerline temperature of the rod. (20%)



3 In applying the Newton's law of cooling, the heat transfer coefficient is determined empirically by various heat transfer empirical correlations. When an engineer wants to choose a heat transfer correlation to calculate the heat transfer coefficient for his very specific situation, please list the important things he have to pay attention to (20%).

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4. A thermal couple junction, which may be approximated as a sphere, is to be used for temperature measurement in a gas stream. The convective heat transfer coefficient between the junction surface and the gas is h = 400 W/m^2 K, and the junction thermophysical properties are k = 20 W/ m K, c = 400 J/kg K, and density is 8500 kg/m^3. Determine the junction diameter needed for the thermocouple to have a time constant of 1 sec. If the junction is at 25 C and is placed in a gas stream that is at 200 C, how long will it take for the junction to reach 199 C (20%)?

5. For flow of a liquid metal through a circular tube, the velocity and temperature profiles at a particular axial location may be approximated as being uniform and parabolic, respectively. That is, $u(r) = C_1$ and $T(r) - T_s = C_2 [1 - (r/r_o)^2]$, where C_1 and C_2 are constants. Please show that the Nusselt number at this location is 8 (20%).