系所組別：工程科學系在職專班乙組

考試科目：熱傳學（專班） 考試日期：0223，節次：3

※ 考生請注意：本試題不可使用計算機

I. One side of a plane wall is maintained at 100°C, while the other side is exposed to a convection environment having T = 10°C and h = 12 W/(m$^2$·°C). The wall has k = 1.2 W/(m·°C) and is 40 cm thick. Calculate the heat flux through the wall. (10%)

II. Derive an expression for the temperature distribution in plane wall having uniformly distributed heat source $\dot{q}$ and one face maintained at a temperature $T_1$ while the other face is maintained at a temperature $T_2$. The thickness of the wall may be taken as 2L. (15%)
Hint: the energy equation for the problem can be written as $\frac{d^2T}{dx^2}+\frac{\dot{q}}{k}=0$.

III. The one-dimensional Fourier law can be written as

$$q''=-k\frac{\partial T}{\partial z}$$

(1) What are $q''$, k and $\partial T/\partial z$ ? (6%)

(2) What is the meaning of the negative sign in the equation? (4%)

(3) If the Fourier is re-written as

$$q''=k\frac{\partial T}{\partial z},$$

is it correct? Why or Why not? (5%)

IV. Explain the following terms: (20%)

(1) Heat conduction equation or Heat diffusion equation

(2) Heat transfer rate

(3) Specific heat

(4) Thermal diffusivity

(5) Nusselt number

V. Answer the following questions: (25%)

(1) What are the differences between heat transfer and thermodynamics?

(2) 以熱傳觀點，來闡釋發熱衣的禦寒效果？

(3) 核電廠發生事情，為何大都是與熱傳問題有關？

(4) 以熱傳觀點，來闡釋羽毛衣的禦寒效果？

(5) 高功率元件，常以鰭片(fin)幫助散熱。請以熱傳觀點，闡釋其理由。

VI. The temperature distribution across a wall 1m thick at certain instant of time is given as

$T(x) = a + bx + cx^2$

where T is in degrees Celsius and x is in meters, while a = 900°C, b = -300°C/m, and c = -50°C/m$^2$. A uniform heat generation, $\dot{q}=2000W/m^3$, is present in the wall of area 10 m$^2$ having properties $\rho$ = 1000 kg/m$^3$, k = 40 W/m·K, and $c_p$ = 4 kJ/kg·K.

(1) Determine the rate of heat transfer entering the wall (x = 0) and leaving the wall (x = 1m). (8%)

(2) Determine the time rate of temperature change at x = 0.5 m. (7%)

Hint: $\frac{\partial T}{\partial t}=\frac{k}{\rho c_p}\frac{\partial^2 T}{\partial x^2}+\frac{\dot{q}}{\rho c_p}$