Menoufiya University Faculty of Engineering Shebin El-Kom Academic Year 2014-2015	Minufiya University	Department: Mech. Power Eng. Year: Diploma High Studies Subject / Heat Transfer Time: 3 hours Date: January 2015

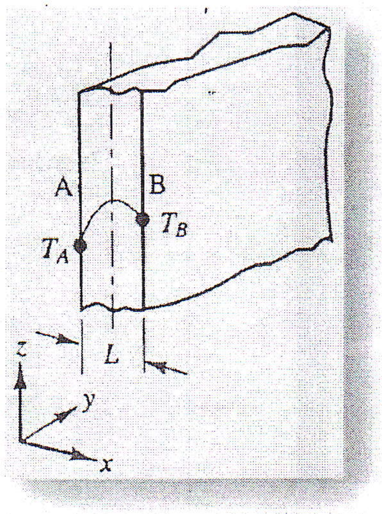
Please, answer the following questions: (Total Marks 100)

Assume any missing data

Question (1): (25 Marks)

1.1) *Derive the temperature equation at an exterior corner node with one adjacent side insulated and one adjacent side subjected to convective heat transfer in terms of the adjacent nodes for the applications of finite difference method.*

1.2) *A large plate of thickness $L = 2$ cm with constant thermal conductivity $k = 0.5$ W/m.K and uniform heat generation $q = 1000$ kW/m^3. The faces A and B are at temperatures of 100 °C and 200 °C respectively. Assuming one-dimensional steady-state diffusion, write down the governing differential equation for temperature distribution. Using the finite volume method with dividing the domain into five control volumes and considering a unit heat transfer area, calculate the steady-state temperature distribution.*



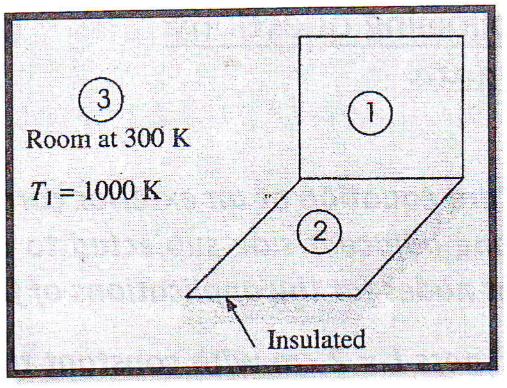
Question (2): (25 Marks)

2.1) *Beginning from the temperature distribution, deduce relations for calculating the efficiency and effectiveness of a thin and long triangular fin.*

2.2) *Find the rate of heat flow through a thin and long triangular iron fin of 5 mm thickness, 50 mm height, and 1m width. Determine also the fin efficiency and effectiveness, if the temperature difference between the base and the surroundings is 80°C. The thermal conductivity of iron is 58 W/m.K and the convective heat transfer coefficient is 10.44 W/m^{2}K.*

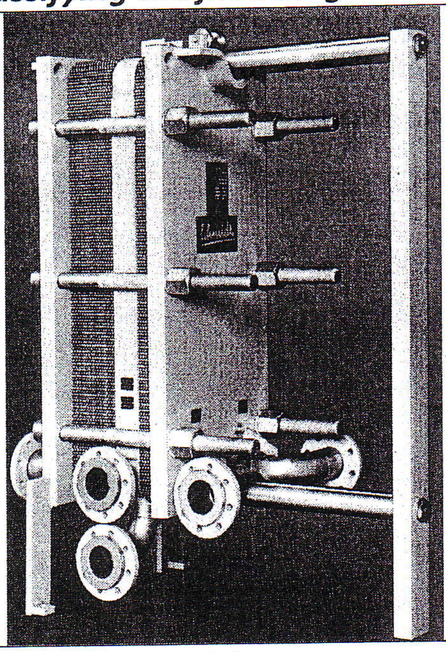
Question (3): (25 Marks)

Two rectangles 50 by 50 cm are placed perpendicularly with a common edge. One surface has T_1 = 1000 K, ε_1 = 0.6, while the other surface is insulated and in radiant balance with a large surrounding room at 300 K. Determine the temperature of the insulated surface and the heat lost by the surface at 1000 K. (Take $\sigma = 5.669\times10^{-8}$ W/m^2K^4).

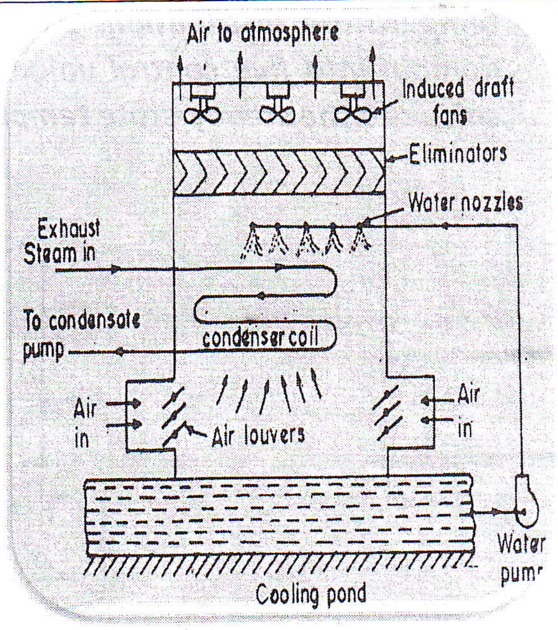


Question (4): (25 Marks)

4.1) Classifying the following heat exchangers according to all possible categories:



(a)



(b)

(4.2) A single tube pass, parallel-flow regime, shell-and-tube heat exchanger has equal capacity rates. Determine the overall effectiveness of the heat exchanger if one, two or three segmental baffles are mounted on the shell-side. Take the cell effectiveness of a cross-flow, single pass heat exchanger to be 40%.

With the best wishes