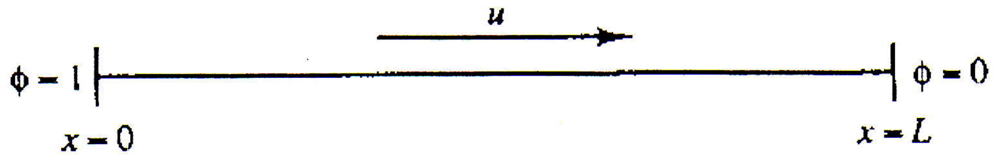
Menoufia University **Faculty of Engineering** **Shebin El-Kom** **1[th] Semester** **Academic Year: 2017-2018**	**Post Graduate: Master** **Department:** ***Mechanical Power*** **Subject:** ***(MPE620)*** **Time Allowed: 3 hrs** **Date: 10 /1/2018**

Minufiya University

Note: Assume any data required , state your assumption clearly. Answer all the following Questions

Question (1) (30 Marks)

A property □ is transported by means of convection and diffusion through the one – dimensional domain sketched in the figure. The governing equation is $\frac{d\rho u\phi}{dx} = \frac{d}{dx}\left(\Gamma(\frac{d\phi}{dx})\right)$ the boundary conditions are $\phi_o = 1.0$ at x=0 and $\phi_L = 0.0$ at x=L. Using five equally spaced cells and the central differencing scheme, calculate the distribution of □ as a function of x. The following data apply u=2.5 m/s, length L=1.0 m, ρ=1.0 kg/m^3, $\Gamma = 0.1$ kg/m.s.

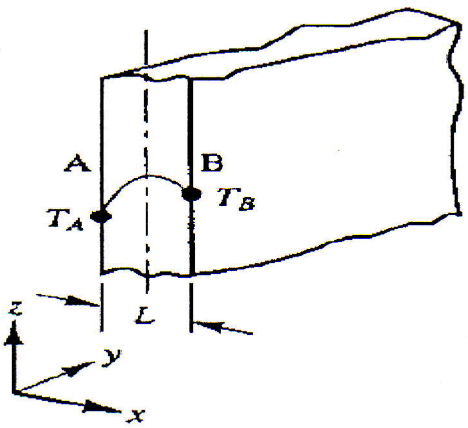


Question (2) (30 Marks)

Figure shows a large plate of thickness L=2 cm with constant thermal conductivity k=0.5 W/m.K and uniform heat generation q=1000 W/k m^3. The face A and B are at temperatures of 100 °C and 200°C respectively. The one – dimensional problem sketch in figure is governed by

$$\frac{d}{dx}(k\frac{dT}{dx}) + q = 0$$

Calculated the steady state temperature distribution in the rod. Compare the numerical result with the analytical solution $T = \left[\frac{T_B - T_A}{L} + \frac{q}{2k}(L - x)\right]x + T_A$

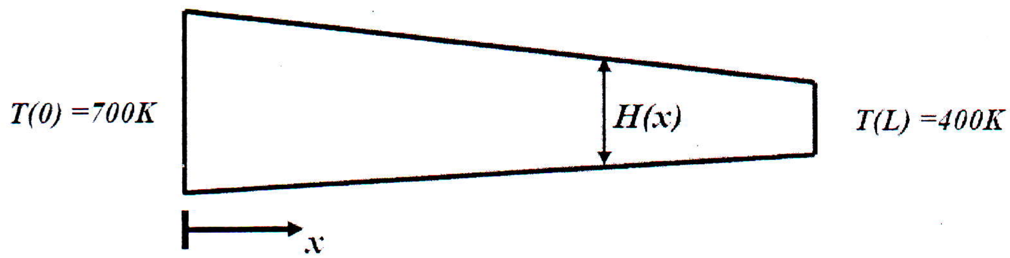


Question (3) **(20 Marks)**

The heat transfer equation in trapezoidal fine shown in the next figure is given by

$$\frac{\partial}{\partial x}\left(kA(x)\frac{\partial T}{\partial x}\right)+hP(x)(T-T_{\infty})=0$$

Where, k is the thermal conductivity, $P(x)$ and $A(x)$ are the perimeter and cross sectional area of the fin at any x. given that: k = 19 W/m.K, T_{∞}=300K, h = 2 W/m^{2}K, the fin length is 50 cm and fin width (perpendicular to paper) is 15 cm, the find height is $H(x)$ = 5-0.005x cm. Calculate the temperature distribution along the fin using five grid points



Question (4) **(20 Marks)**

The x- component of Navier-Stokes equation in two-dimensional with no body force can be written as: $\frac{\partial \rho u^2}{\partial x}+\frac{\partial \rho uv}{\partial y}=-\frac{\partial p}{\partial x}+\frac{\partial}{\partial x}\left(\mu\frac{\partial u}{\partial x}\right)+\frac{\partial}{\partial y}\left(\mu\frac{\partial u}{\partial y}\right)$

Drive the finite volume difference equation over a staggered grid and show how the under-relaxation affect the coefficient of the obtained equation. Drive also, an expression for pressure correction equation using SIMPLE algorithm

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GOOD LUCK

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