Menoufia University
Faculty of Engineering
Shebin El-Kom
2th Semester
Academic Year: 2017-2018

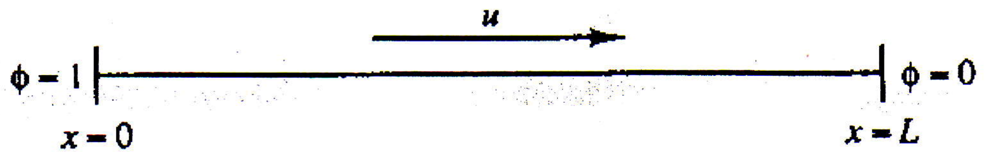
Minufiya University

Post Graduate: Master
Department: ***Mechanical Power***
Subject: ***(MPE620)***
Time Allowed: 3 hrs
Date: 30/5/2018

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

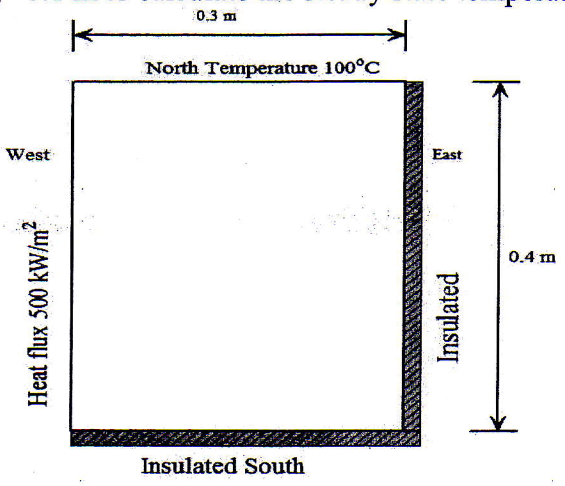
Question (1) (30 Marks)

A property ϕ 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 ϕ as a function of x. The following data apply u=2.5 m/s, length L=1.0 m, ρ=1.0 kg/m³, $\Gamma = 0.1$ kg/m.s.



Question (2) (30 Marks)

In figure a two- dimensional plate of thickness 1cm is shown. The governing equation is $\frac{\partial}{\partial x}\left(k(\frac{\partial T}{\partial x})\right) + \frac{\partial}{\partial y}\left(k(\frac{\partial T}{\partial y})\right) = 0.0$. The thermal conductively of a plate material is k=1000 W/m.K. The west boundary receives a steady heat flux of 500 kW/m² and the south and east boundaries are insulated. If the north boundary is maintained at a temperature of 100 °C, use a uniform grid with Δx=Δy=0.1 m to calculate the steady state temperature distribution at nodes

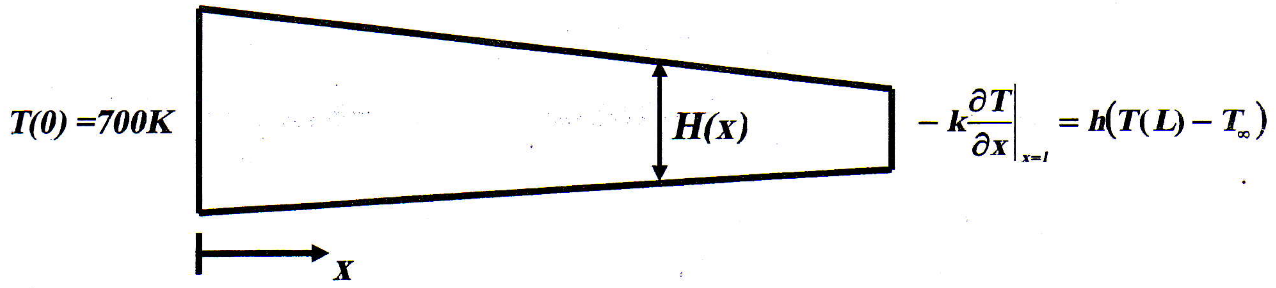


Question (3) (20 Marks)

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/m²K, the fin length is 50 cm and fin width (perpendicular to paper) is 15 cm, the find height is ***H(x)*** = 5-0.005***x*** 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

GOOD LUCK

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