Koç University, MECH 307 Numerical Methods for Mechanical Engineering
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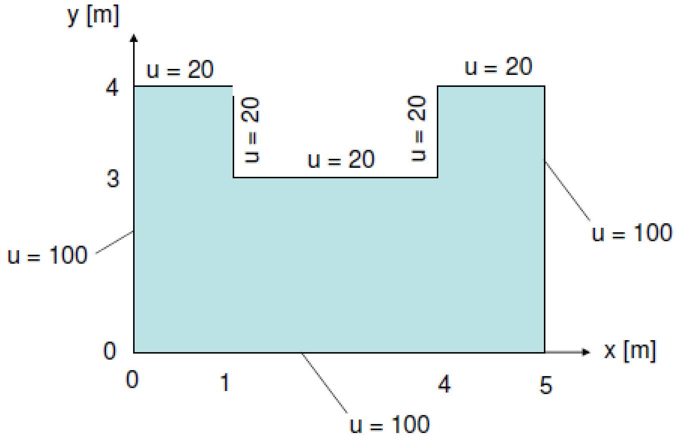
HW7 (related to Chapter 15; Laplace and unsteady Heat Equations)

For problems 1, 2 and 3, use finite-difference method to solve for u(x,y) where $\nabla^2 u = 0$.

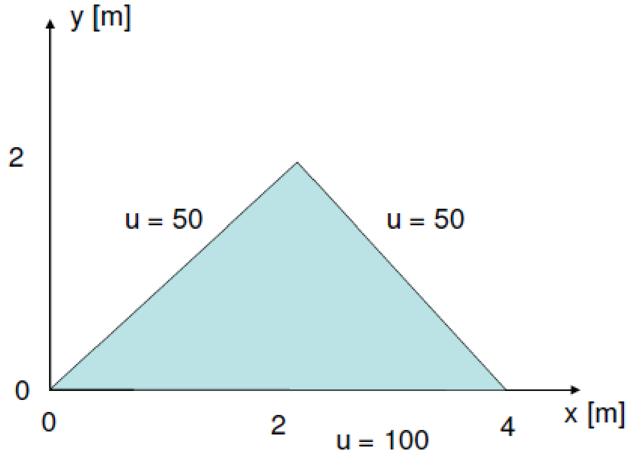
Problem 1



(a) Plot u (x,2) versus x.
(Take $h_x = h_y = 0.1$.)

(b) u(2.5, 2) = _____________.

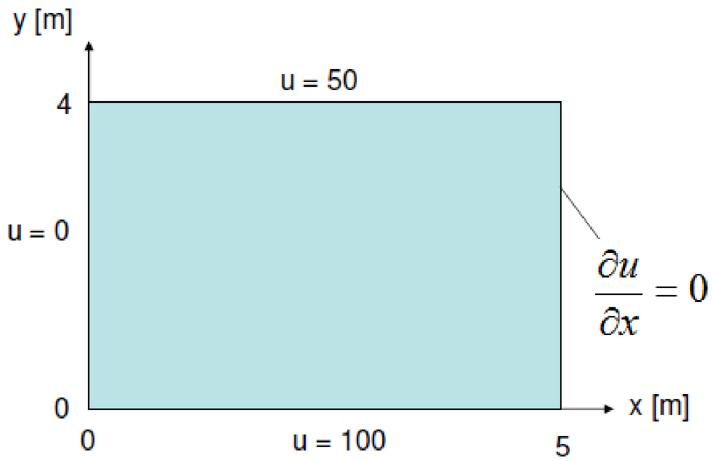
Problem 2



(a) Plot u (2,y) versus y.
(Take $h_x = h_y = 0.1$.)

(b) u(2, 1) = _____________.

Problem 3



(a) Plot u (x,y) using contourf with color bars. (Take $h_x = h_y = 0.1$.)

(b) u(2.5, 2) = _____________.

CAUTION: The right edge has a derivative boundary condition!

For problems 4,5 and 6, **use finite-difference method to solve for u(x,y,t). This time:**

$$\partial u/\partial t = c\, \nabla^2 u, \text{ where } c = k / (\rho\, c_p)$$

Material are aluminum, where $c = 56.4 \times 10^{-6}$ m²/s.

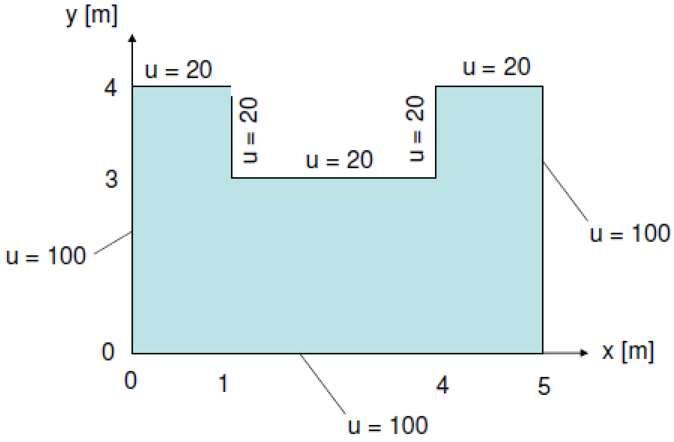
Take $T_{initial}$ = **200˚C** everywhere in domain, and solve until T_{max} < **125˚C** before answering following questions. Also take r = 0.1 .

Problem 4

(a) T_{max} < 125˚C when t = ______________s.

(b) Plot u(x,2) versus x.
(Take $h_x = h_y = 0.1$.)

(c) u(2.5, 2) = _____________.

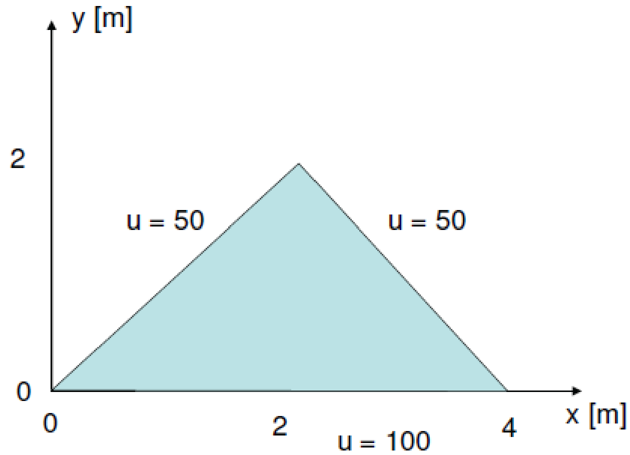


Problem 5

(a) T_{max} < 125˚C when t = ______________s.

(b) Plot u(2,y) versus y.
(Take $h_x = h_y = 0.1$.)

(c) u(2, 1) = _____________.



Problem 6

(a) T_{max} < 125˚C when t = ______________s.

(b) Plot u(x,y) using contourf with color bars. (Take $h_x = h_y = 0.1$.)

(c) u(2.5, 2) = _____________.

CAUTION: The right edge has a derivative boundary condition!