Problem 3

Versió 6 (la més recent)

Pregunta 1

Correcte

Puntuació 10,00 sobre 10,00

Given the BVP problem,

$$\sigma\frac{\partial u}{\partial t} - \frac{\partial}{\partial x}\left(x\frac{\partial u}{\partial x}\right) = 0, \qquad 1 \le x \le 2, \quad t \ge 0$$

with boundary conditions,

$$u(t,1) = 1.0, \quad u(t,2) = -49.0, \qquad t \ge 0$$

and initial condition

$$u(0,x) = 1 + 50.0\cos\left(\frac{\pi x}{2}\right), \qquad 1 \le x \le 2,$$

following practice P2.3, we want to compute its FEM solution with 500 divisions of the domain $\Omega = [1,2]$ for both, the stationary ($\sigma = 0$) and the transient case (with $\sigma = 1$). For the latter, use the Crank Nicolson method ($\alpha = 1/2$) to integrate the time-ODE system from $t_{ini} = 0.0$ to $t_{fin} = 0.2$ taking a time step $dt = 0.01$. From the FEM solutions found, answer the following questions:

(a) (4 points) Compute the stationary solution and, as we did in Practice P2.2, give the error, ε, when comparing the numerical solution with the exact solution

$$\tilde{u}(x) = \frac{-50.0}{\log 2}\log x + 1.0,$$

and we define ε as

$$\varepsilon = \|\tilde{u}(x) - u_{num}\|_\infty = \max\ \tilde{u}(x_k) - u_{num}(x_k)\ .$$

- 1.5225e-06 ✔
- 1.3043e-06
- 1.5923e-06
- 1.1764e-06
- Leave it empty (no penalty)

Puntuació 4,00 sobre 4,00

La resposta correcta és: 1.5225e-06

Hint. The nodal value of the stationary solution at node 120 is $u_{120} = -1.4401e+01$

(b) (3 points) Approximate the stationary solution at the point $x_p = \sqrt{3}$ by linear interpolation from the nodal solution using the element's nodes to which the point belongs. The result is:

- -3.8624e+01 ✔
- -4.3336e+01
- -4.3142e+01
- -4.1355e+01
- Leave it empty (no penalty)

Puntuació 3,00 sobre 3,00

La resposta correcta és: -3.8624e+01

(c) (3 points) Finally, from the transient solution u_t for this problem (according to the previous set values), give the mean of all the nodal values at $t = t_{fin} = 0.2$

- -2.7075e+01 ✔
- -2.7046e+01
- -2.4390e+01
- -2.4886e+01
- Leave it empty (no penalty)

Puntuació 3,00 sobre 3,00

La resposta correcta és: -2.7075e+01

Hint. The value in the final transient solution at node 120 is $u_t(120) = -1.4668e+01$

Torna a començar | Desa | Emplena amb les respostes correctes | Envia i acaba

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