GX1660

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NATIONAL UNIVERSITY OF IRELAND, GALWAY

SUMMER EXAMINATIONS, 1999

CS305
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Professor J.N. Flavin;
Dr.P.M. O'Leary.
Time allowed: *Two* hours
Full marks for TWO questions

1. Obtain the two-term Galerkin approximate solurion to the problem defined by

$$-\frac{d^2u}{dx^2} + 9u = x$$

subject to the conditions $u(0) = 0, u(2) = 0$.

Use the trial functions $\phi_1 = x(2-x), \phi_2 = x\phi_1$, or any other functions that you choose.

2. Let$R$ denote the rectangular region $3 \geq x \geq 0, 2 \geq y \geq 0$. If $u(x, y)$ satisfies the equation

$$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial x^2} = y \text{ in } R$$

subject to $u = 0$ on the boundary, construct the Galerkin approximation to the problem using the trial function

$xy(3-x)(2-y)$.

p.t.o.

3. Consider the problem

$$\begin{aligned}-\frac{d^2u}{dx^2}+4u &= 1, 0 < x < 1\\ u(0) &= u(1) = 0.\end{aligned}$$

The region$[0,1]$ is divided into four regions of equal length, and the approximate solution is given by $\sum_{i=0}^{4} c_i\phi_i(x)$,where $\phi_i(x)$ are linear functions satisfying the conditions $\phi_i(x_j) = \delta_{ij}$,where $\delta_{ij} = 1$ for $i = j, \delta_{ij} = 0$ for $i \neq j$, and where the nodes x_j denote the end-points of each element. In that case show that the above problem reduces to the set of equations

$$\begin{bmatrix} 98/12 & -95/24 & 0 \\ -95/24 & 98/12 & -95/24 \\ 0 & -95/24 & 98/12 \end{bmatrix}\begin{bmatrix} c_1 \\ c_2 \\ c_3 \end{bmatrix} = \begin{bmatrix} 1/4 \\ 1/4 \\ 1/4 \end{bmatrix}$$

4. Write a MAPLE procedure to solve *any* of the last three questions.
5. Give examples off the use of the following commands in MAPLE:
   (i) evalf;
   (ii) animate;
   (iii) proc.