Faculty Name	:	**Dr.M.Subramanian, Prof & Head/ Aerospace**	Academic Year	:	**2024-2025 (Odd)**
Year & Branch	:	**III Aerospace**	Semester	:	**V**
Course	:	**19ASB302 – Finite Element Method for Aerospace**			

Unit:

The differential equation of a physical phenomenon $\frac{d^2y}{dx^2} + y = 4x \quad 0 \le x \le 1$. Trial functions i) $y = a_1 x(x-1)$ ii) $y = a_1 x(x-1) + x$, the boundary conditions are $y(0) = y(1) = 1$. One term approximate solution by galerkin's method of weighted residue.

Solution:-

Verify boundary condition.

$y = a_1 x(x-1)$

$y(0) = a_1(0)(0-1)$

$= 0$

$y(1) = a_1(1)(1-1)$

$= 0$

Here the boundary conditions are not homogenea so we assume a trial function as

$y = a_1 x(x-1) + x$

$y(0) = a_1(x^2 - x) + x$

$= a_1 \times 0$

$y(0) = 0$

$y(1) = a_1(1)(1-1) + 1$

$= 1$

Residual

$y = a_1 x(x-1) + x$

$\frac{dy}{dx} = a_1(x^2 - x) + x$

$= a_1(2x-1) + 1$

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$\frac{d^2y}{dx^2} = a_1(2)$

$= 2a_1$

$\frac{d^2y}{dx^2} + y = 4x$

$2a_1 + y = 4x \longrightarrow (1)$

Sub the y value in (1).

$2a_1 + a_1x(x-1) + x = 4x$

$2a_1 + a_1x^2 - a_1x + x = 4x$

$2a_1 + a_1x^2 - a_1x + x - 4x = R(x)$

Galerkin Method

$\int w_i R_x \, dx = 0$

$y = a_1 x(x-1) + x.$

$= a_1 w_i + x$

$w_i = x(x-1).$

$\int_0^1 x(x-1)\left[2a_1 + a_1x^2 - a_1x + x - 4x\right] dx = 0.$

$\int_0^1 x(x-1)\left[2a_1 + a_1x^2 - a_1x - 3x\right] dx = 0$

$\int_0^1 \left[2a_1x^2 + a_1x^4 - a_1x^3 - 3x^3 - 2a_1x - a_1x^3 + a_1x^2 + 3x^2\right] dx = 0.$

$2a_1\left[\frac{x^3}{3}\right]_0^1 + a_1\left[\frac{x^5}{5}\right]_0^1 - a_1\left[\frac{x^4}{4}\right]_0^1 - 3\left[\frac{x^4}{4}\right]_0^1$

$-2\left[\frac{x^2}{2}\right]_0^1 - a_1\left[\frac{x^4}{4}\right]_0^1 + a_1\left[\frac{x^3}{3}\right]_0^1 + 3\left[\frac{x^3}{3}\right]_0^1 = 0.$

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DEPARTMENT OF AEROSPACE ENGINEERING

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$$\frac{2a_1}{3}+\frac{a_1}{5}-\frac{a_1}{4}-\frac{3}{4}-\frac{2a_1}{2}-\frac{a_1}{4}+\frac{a_1}{3}+\frac{3}{3}=0.$$

$$0.666a_1+0.2a_1-0.25a_1-0.75-a_1-0.25a_1+0.333a_1+1=0.$$

$$-0.301a_1=-0.25$$

$$a_1=0.830.$$

$$y=0.830x(x-1)+x$$

$$=0.830x^2-0.830x+x$$

$$=0.830x^2+0.17x.$$