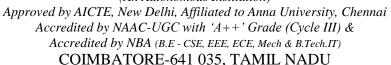


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DEPARTMENT OF AEROSPACE ENGINEERING

Faculty Name : Dr.M.Subramanian,

Academic Year

2024-2025 (Odd)

Year & Branch

Prof & Head/ Aerospace

G 4

2024-2023 (Odu)

Course

III Aerospace

Semester

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Course

19ASB302 – Finite Element Method for Aerospace

Unit: 1

The differential equation of physical phenomenon is given by $\frac{d^2y}{dx^2} + 500x^2 = 0$, $0 \le x \le 1$,

Trial function, $y = a_1(x - x^4)$, Boundary condition are, y(0)=0, y(1)=0 calculate the value of the parameter a_1by the following methods. (i) Point collocation method (ii) Sub-domain collocation method (iii) least Square Method and (iv) Galerkin's method.

tiven: Differential equation $\frac{d^2y}{dx^2 + 500x^2 = 0}$, oracl Trial function y = a, (x-x+) Boundary condition one, y(0)=0, y(0=0 To find: The value of parameter a, by, i. Point collocation method, ii. Subdomain method, iii. Least Squares method, iv. Galerkin Solution: First we have to verify, whether the trial function satisfies the boundary condition Trial function is, y = a, (x-x4) When 0c = 0, $y = a_1(0-0) = 0$ x = 1 $y = a_1 (1 - 14) = 0$ Hence it satisfies the boundary conditions, (i) point Collocation method: $y = a_1(x - och)$ $dy/dx^{2}=9i(1-4x^{3})$ $\frac{d^{2y}}{dx^{2}} = a_{1} (0 - 12x^{2})$ $\frac{d^{2y}}{dx^{2}} = -12a_{1} = 2$



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Prof & Head/ Aerospace

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19ASB302 - Finite Element Method for Aerospace

Unit: 1

Substituting der value in given differential equation (1), -> der + 500x2=0

→ Residual, R=-12a, x2+500x2

In point collocation wetter, residuals are set to zero.

R = -12a,0c2 + 5000c2 = 0 ->3

In this problem, we have to find only one parameter, a, so, only one Collocation point is needed.

The point way be chosen between of

Substituting oc = = in equation®

 $R = -12 \, a_1 \left[\frac{1}{3} \right]^2 + 500 \left[\frac{1}{2} \right]^2 = 0$

 \Rightarrow -12 a, $\left[\frac{1}{4}\right]$ + 500 $\left[\frac{1}{4}\right]$ = 0

-3a, +125 =0

Hence the total functionis 4=41.66(x-x4)





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Faculty Name

Prof & Head/ Aerospace
III Aerospace

Semester

r 7

Course

19ASB302 – Finite Element Method for Aerospace

Unit: 1

Gi) Subdomain collocation method:

This wetbod requires
$$\int Rdx = 0$$

Substitute R Value $\int [-12a_1x^2 + 500x^2]dx = 0$
 $\int [-12a_1x^2 + 500x^2]dx = 0$
 $\int [-12a_1] \int [-0] + \frac{500}{3} \int [1-0] = 0$
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Unit: 1

We know that,
$$R = -12a_1x^2 + 500x^2$$
 $\frac{\partial R}{\partial a_1} = -12x^2$

Substitute R and $\frac{\partial R}{\partial a_1}$ values in eq (6)

 $\Rightarrow \frac{\partial I}{\partial a_1} = \int [-12a_1x^2 + 5xxx^2] (-12x^2) dx$

The requirement is, $\frac{\partial I}{\partial a_1} = 0$
 $\Rightarrow \int [-12a_1x^2 + 500x^2) (-12x^2) dx = 0$
 $\int [14+a_1x^4 - 6000x^4) dx = 0$
 $\int [14+a_1x^4 - 6000x^4] dx = 0$
 $\int \frac{144a_1}{5} [1-0] - \frac{6000}{5} [1-0] = 0$
 $\int \frac{144a_1}{5} [1-0] - \frac{6000}{5} [1-0] = 0$
 $\int \frac{144a_1}{5} [1-0] - \frac{6000}{5} [1-0] = 0$





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(IV) Tralerkin's method: In this wethod, the trial function itselfs is considered as the weighting function, wi > \ \wiRd\co Here, the trial function is $y = \mu_i = a, (x - x^4)$ Substitute Wi and R Values in equation @ $\int (x-oc^{4}) (-12a_{1}x^{2}+500x^{2}) dx = 0$ $a_1 \int (x-x^4) (-12a_1 xc^2 + 500 xc^2) clsc = 0$ [-120/x3+500x3+124/x6-500x6] dx=0 $a_1 \left[-12a_1 \left[\frac{3c47}{4} \right] + 500 \left(\frac{3c47}{4} \right] + 12a_1 \left(\frac{3c77}{4} \right) - 500 \left(\frac{3c77}{4} \right) = 0$ $\frac{-12a_1}{4} \left(1-0 \right) + \frac{500}{4} \left(1-0 \right) + \frac{12a_1}{7} \left(1-0 \right) - \frac{500}{7} \left(1-0 \right) \mathcal{D}$ -39,+125+1-71AQ1-71.428 =0 -1.286 Q, = -53.572 9,=41.66 Total function is y=4166(x-x4) From equation 4, 5, 4, and 9, we know that the Value of parameter a, is Same for all