Department of Applied Mechanics

Computational Mechanics (AML 310)

Major Examination

04/05/2009

Q – 1 For a given set of simultaneous equation $\{A\}\ \{x\} = \{c\}$ develop the complete formulation in terms of *'n'* set of equations for the unique solution if the co – efficient matrix $\{A\}$ is non singular. Give the algorithm most suited to obtain the solution.

Q – 2 Solve the Poisson's equation

$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = -10(x^2 + y^2 + 10)$ in the given domain of size {10X10} taking h = 1, using central difference approach with error estimate of h^2

a. Horizontal and vertical boundaries have U = 50 and 100 respectively.
b. Reduce the problem as per symmetry and show the requisite boundary conditions.
c. Use cross / diagonal averaging to make first iteration.

Q – 3a. For the given speed – up model in parallel processing, show the case of perfect average and maximum degree of parallelism

$S_p = \frac{T}{\left(\alpha_1 + \frac{\alpha_2}{K} + \frac{\alpha_3}{p}\right)T + t_d}$ all symbols stand for their standard meaning.

b. For a common parallel programming paradigm. What are different workload allocation strategies?

Q – 4 a. Name five schemes of weighted residual methods. How are they used to model a continuum to obtain field unknowns.

b. Solve the following boundary value problem for first approximation using Rayleigh – Ritz method.

$\frac{d^2y}{dx^2} - x = 0,\ y(0) = 0\ \&\ y(l) = \frac{-1}{2}$

The functional for the problem is

$J(y) = \int_0^l \left[\left(\frac{dy}{dx}\right)^2 + 2yx\right] dx$

Using approximate function, $y(x) = \alpha_1 + \alpha_2 x^2$

Q – 5 Find a real trial root of the two coupled non – linear equations using an algorithm for Taylor Series iterative procedure.

$x = 0.2x^2 + 0.8$

$y = 0.3xy^2 + 0.7$

Q – 6 How the numerical simulation of the following cases are possible?

a. Torque transmission through gear system. Where do the maximum stress occur and why?

b. Critical combination of loads on a gas turbine engine shaft during a flight.

c. A tall chimney against static wind force.

d. Flow of air through a. helmet using partial differential equations. What is a finite volume technique?