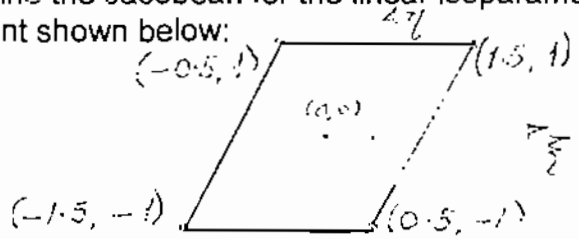
APPLIED MECHANICS DEPARTMENT

AM705 FINITE ELEMENT METHODS IN STRESS ANALYSIS

Time : 2 hrs) **Major Test – 28/11/2005** **(Max. marks: 40**

1. a) Determine the Jacobean for the linear isoparametric quadrilatral element shown below:



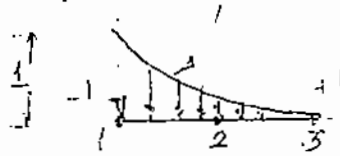
b) Compute the Integral over the parallelogram domain using
   i) one point integration
   ii) 2x2 integration

$$I = \int\int_{\Omega} (\xi^{**}2\, \eta^{**}2 + \xi\eta + \xi + \eta)\, dx\, dy$$

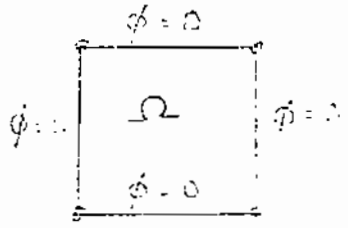
2. a) Derive expressions for the mass and stiffness matrices of a one dimensional three noded bar element assuming the shape functions as

$N1 = -\xi\,(\xi+1)/2 \qquad N2 = (1-\xi^{**}2) \qquad N3 = \xi\,(\xi+1)/2$

b) Compute the equivalent nodal load for the traction distribution as shown below on a quadratic element



3. Give a one parameter Galerkin solution for the following equation for the Rectangular domain shown below :



$$\frac{\partial^2 \phi}{\partial x^2} + \frac{\partial^2 \phi}{\partial y^2} = 1 \quad \text{on } \Omega$$

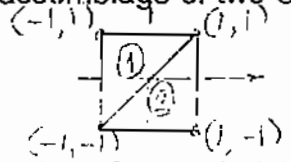
- or -

For the deformation of a beam on elastic foundation in dimensionless variables

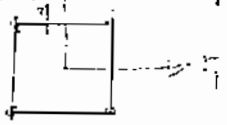
$$d^4u/dx^4 + u = 1$$

with the boundary conditions $u = d^2u/dx^2 = 0$ at $x = 0$ and $x = 1$. Choose the basis functions $\{ \sin \pi x , \sin 3\pi x \}$ and use Galerkin method to find an approximate solution.

4. Derive the B matrix for a CST triangle. Consider a square domain shown below as an assemblage of two CST triagles as shown below:



Cornpare this with a four noded bilinear element with the value being computed at the centroid of the square.



5. Obtain the forces in the members of a plane truss shown below:
E = 200 GPa A = 200 sq.mm. Also determine support reactions.
Use finite elements.